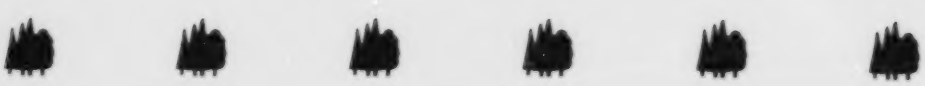
FOREST RESOURCES COMMISSION

Background Papers - Volume 7

Report on the Current Status of Forest Resource Inventories of British Columbia

A Summary of Technical Reviews of Forest Inventories and Allowable Annual Cut Determinations in British Columbia
- HST Consortium



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The views expressed in independent reports prepared for the Forest Resources Commission are those of the authors and not necessarily those of the Commission. They are published in their entirety for the use and interest of the public as background studies to the April 1991 Report of the Commission to the Minister of Forests.

REPORT ON
THE CURRENT STATUS OF
FOREST RESOURCE INVENTORIES
OF BRITISH COLUMBIA

Prepared for:

THE BRITISH COLUMBIA FOREST RESOURCES COMMISSION

February 1990

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INTRODUCTION

The status of forest resource inventories in British Columbia has far-reaching effects on integrated resource management. The Ministry of Forests (MOF) is mandated to ensure that all resource values are taken into account when managing the province's forest and range lands. Forest managers and the public cannot properly assess land use conflicts without an adequate inventory of each resource.

An overview of the status of the present resource inventory for each of the following users of forest and range land has been completed:

- Timber;
- Wildlife;
- Fisheries;
- Range;
- Recreation;
- Wilderness;
- Tourism;
- Water.

An insight into issues concerning each forest resource inventory and the implications for the development of an economically sustainable forest industry in the province were to be determined as part of the review.

The main approach used in the review was personal and telephone interviews with a wide range of individuals who are involved with the acquisition, maintenance and use of forest resource inventories. A questionnaire was circulated as well. Ministry, Branch and Regional staff responsible for preparing the respective inventories were the main contacts. Information was received from:

- B.C. Ministries of Forests, Environment, Tourism, Recreation and Culture, Crown Lands, Parks, Native Affairs;

- Federal Departments of Fisheries and Oceans, Environment;

- B.C. Wildlife Association;

- TFL and Forest Licence licensees;

- Interviews with selected individuals with expertise and knowledge of the inventories of interest.

A folio of map overlays was prepared. The folio illustrates at a provincial level the forest land base by Region and tenure, the forest site capability and the boundaries of Indian land claims.

TERMS OF REFERENCE

The Commission was interested in an evaluation of the status of British Columbia's forest resource inventories.

The intent of the study was to provide specific information on the following:

PRODUCTIVE LAND BASE

- Total land area
- Forested land area
- Productive forest area

This information was to be presented by a base map of the province showing Forest Regions, Timber Supply Areas (TSA) and Tree Farm Licence boundaries.

FOREST SITE CAPABILITY

The biological capability of different forest areas to grow forest crops is to illustrate at provincial level by geographic location in the province. This is to be provided as an overlay map to the provincial scale map.

INDIAN LAND CLAIMS

A provincial scale map is to be produced to show the extent of the current Indian land claims on boundaries of the "working forest." This map is to be provided as an overlay to the provincial scale map.

RESOURCE INVENTORIES

- Report on the present status of each forest resource inventory.
- Provide a summary of what is needed to improve the information of each inventory.

The study emphasis for each resource is:

- Goals and objectives;
- Completeness;
- Accuracy;
- Intended uses;
- Adequacy of maintenance processes and procedures.

Appropriateness for use in developing land use policy and strategies for sustainable development.

SUMMARY OF FINDINGS

In this section we outline in general terms our overall findings of the status of the forest resource inventories within a provincial context. A summary of the status of each particular resource inventory heads each individual report, and can be referred to for additional detail.

It is not possible to summarize our findings in quantitative terms because the information could not be obtained in a standard consistent format, nor was that type of information available for each inventory. Our findings are discussed under the following headings:

GOALS AND OBJECTIVES

Most of the ministry resource managers interviewed were able to state what their inventory requirements are and have prepared written goals and objectives. However, they are not consistently well stated or defined for each resource, and are quite variable. To set clearer direction, clear and stronger goals and objectives need to be defined.

COVERAGE

Provincial coverage by each inventory is highly variable and quite incomplete. At a broad management level, the coverage ranges from good to poor. At an operational level (needed to practise integrated resource management), the coverage is adequate. Only the Timber Inventory covers the entire province.

COMPLETENESS

In terms of the data gathered, not one resource inventory can claim to have a completed database that is updated and maintained that fulfills its inventory objectives or management goals. The data gaps are substantial. Even the Timber Inventory, which has the most complete information, has a large amount of outdated data. All ministries are planning to have their data and maps on

interactive computer-based Geographic Information Systems (GIS) which will at least make their present data more usable.

RELIABILITY

It is difficult to make comparisons on the relative reliability of each inventory. Of the resources that can be inventoried with a statistical reliability, only Timber was able to provide a standard error estimate. Wildlife and Fisheries inventories, although they involve population estimates, due to difficulties of sampling accurately, were either based on old data or best estimates. Wilderness, Recreation and Tourism are new inventories, using subjective classifications and are regarded as first approximations. Each resource inventory has its own specific limitations.

FUNDING

A consistent reason given by nearly all the Ministry resource managers interviewed for the inadequate or incomplete inventory was insufficient funding. With the exceptions of Water and Range inventories, all clearly felt that better inventories were needed. Many alluded to budget requests that were consistently refused. This would indicate a lack of support or commitment by the government to improving the resource inventories. We were unable to obtain current annual budget requirements for all inventories, but estimates of annual budgets were obtained for the following: Timber - $13.5 million, Wildlife Population - $2.5 million; Wildlife Habitat - $2.4 million ($12 million to complete); Fisheries - $3.0 million additional. It would indicate to us that the annual funding commitment to bring the forest resource inventories to a reasonable level is conservatively in the range of $25-30 million/year.

It is clear that there is not a level base of consistent resource inventory information covering the province. The Timber Inventory is the most complete; Fisheries and Wildlife are inadequate. Recreation, Wilderness and Tourism are first approximations and their inventory methodology is still being developed. Range and Water are inventoried by monitoring the use.

Timber resources not only have the best inventory information but also represent the dominant use. It is difficult for the other resources to participate in integrated resource development, given their poor information base compared to Timber.

There are some obvious linkages between the different resources which suggest there is the need for more co-operative development of inventories sharing common resource interests. For example, inventory of Tourism, Recreation and Wilderness needs compatibility and co-ordination. The open range habitat is shared by both domestic cattle and wildlife.

The linkages in resource uses are particularly relevant for the working forest. This is also where there is the greatest potential for resource use conflicts. Inventories of both forest and non-forest resources need to be completed based on well defined goals and consistent criteria to aid in the resolution of conflicts.

As integrated resource management is a question of resource allocation and use of public land the government needs to provide direction. It will require a commitment to a program to obtain a complete inventory of all the forest resources in the province; and the development of a comprehensive land-use policy and resource allocation strategy for British Columbia.

Summary of the Provincial Land Base

A major portion of the provincial forest area will not grow a commercially-useful timber crop. The productive area or working forest, is the net area used by the MOF to support the provincial annual allowable cut, is an estimated 40% of the provincial landbase.

	TFL's	TSA's	MFU's	TOTAL
Total Forest Area (ha)	7,718,476	43,847,898	742,225	52,308,599 100%
Productive Area (ha)	3,569,914	20,041,291	548,841	24,160,046 46%
Non-Productive Area (ha)	4,148,562	23,806,607	193,384	28,148,553 54%

Source: IRM Branch of MOF for crown lands; BCAA for MFU's. It should be noted that these figures are estimated and that these vary from source to source.

INVENTORY REPORTS

TIMBER RESOURCE INVENTORY

SUMMARY

The Timber Inventory Program of the province is managed by the MOF staff at the Branch, Region and District levels. The total inventory is an estimate of the timber resource of B.C. and is aggregated from inventories of management units; i.e. 35 public TSA's (Timber Supply Areas) and 32 TFL's (Tree Farm Licences).

The majority of the existing forest resource data for the TSA's was collected in 20 years from 1961 to 1980 under the unit survey program. This inventory is largely based on photo interpretation of the forest types (50-80%), stand estimates from helicopter (15-35%) and ground measurements (5-15%).

The Inventory Branch has developed an interactive geographically retrievable multi-resource database and computerized mapping system. Between 1980-87 inventory program was funded at a maintenance level only, the inventory maps being updated for logging and wild fires using satellite image analysis and the database capturing reforestation, stand treatment and history changes.

In 1988 a program was initiated to reinventory the management units over a 10-year period using a refined forest classification system. Procedures are also to be developed to provide stand-specific volume estimates. Although budgeted at $13.5 million per year, this program for TSA's is inadequately funded. In the first two years, the budget for TSA reinventories was approximately $0.50/hectares of productive land. This allows only limited improvement in the classification database, concentrating on the immature component and special problem types, with very limited additional field sampling.

An increase of 40% of the budget for the TSA's re-inventory phase would be required (average cost for TFL's is $2.00/ha) to improve the database for the dynamic computerized inventory system to provide current forest inventory statistics for resource planning.

The TFL inventories, with few exceptions, conform with the MOF inventory standards and procedures with local variations. The original inventory dates, the update status and data management systems vary by TFL and management by individual companies.

INTRODUCTION

The Chief Forester, by authority of the Forest Act (1978), is responsible for the development and maintenance of forest inventory in the province. Thus, the MOF has the mandate to assess Crown lands for their potential for growing trees, providing forest or wilderness oriented recreation, producing forage for livestock and wildlife, conservation of wilderness, and accommodating other forest uses.

The forest inventory program is managed and co-ordinated by staff at the Inventory Branch, Forest Region and Forest District levels. While the Inventory Branch is responsible for the forest inventory of all Crown lands it only performs inventory of provincial forests under Forest Service administration. The responsibility for inventory of Tree Farm Licence lands lies with each licence holder.

Inventory of the forest resource has been an ongoing process since the establishment of the Forest Service in 1912. Broad provincial level inventory reports have been published periodically (e.g., 1917 and 1937).

The purpose of the existing forest inventory that has been carried out during the last 30 years was to provide average management unit level statistics. The intended primary use was for the calculation of annual allowable cuts. It was also to be used to monitor depletion of the forest from harvesting and wildfires, as well as updates for reforestation.

In the following review the provincial inventory program and Tree Farm Licence inventory are described in two sections. Although Tree Farm Licence inventory can be considered a "subprogram", there are enough differences for it to be reviewed separately.

TIMBER SUPPLY AREA INVENTORY

Introduction

Until 1978 the provincial inventory program consisted mainly of management unit surveys, designed to provide average statistics for aggregate forest types. Since then, the emphasis of inventory work has shifted to obtain more detailed information on portions of management units (sub-units), and simultaneously more descriptive statistics such as tree volumes that would be reliable not only for aggregate types, but also for individual forest stands. In addition, the program was enlarged to include monitoring of depletions with the use of satellite imagery and digitizing of forest cover maps.

In 1973 the inventory program was expanded to include the identification of environmentally sensitive areas which should be protected from harvesting, as well as areas which need special consideration when preparing integrated forest development plans.

In 1988, a new program was initiated by the MOF to reinventory the provincial forest inventory on a 10 year cycle and to complete the digital conversion of the remaining forest cover maps by 1991. This program also provides for the updating of all inventory maps on a 2 year cycle, using satellite imagery. These updates will identify changes since the last inventory due to harvesting, fire and damage by insects and disease.

Status

Prior to 1988, the forest inventory available was based on unit surveys completed during the period 1961-75. The inventory provided a completed coverage of the province with maps available at a scale of 1:20 chains. The volume estimates had a standard error of ±10% at a 95% confidence level.

In the late 1970's a refinement was added to the database by identifying and classifying environmentally sensitive areas for all units.

In Appendix A we list the forest units and the years of completion of each unit survey. The inventory was compiled and summarized by the 100 forest unit surveys, which cover the province. In 1979 the forest management units were changed from

Public Sustained Yield Units to Timber Supply Areas. This meant that the inventory database had to be re-organized to coincide with TSA boundaries as broad level forest planning would be at a TSA level. This process was started in 1982 by conversion and updating of the existing database. The source of the TSA inventory database is listed in Appendix B.

The acceptance of the metric system in Canada and the development of computerized mapping and database management systems has resulted in additional progressive changes to the existing inventory. Beginning in the late 1970's the inventory volume database and unit survey statistics were converted to metric units.

The process of converting the approximately 6,600 forest cover maps to a computerized digital format was also started. It is now about 80% complete, and is scheduled for completion by 1991. This was made possible by the additional funding from the re-inventory program.

The design of the unit survey program has its limitations, which have become increasingly apparent in the last 10 years. Deciduous forest types and even lodgepole pine types in some locations were considered at the time of the original unit surveys to be non-commercial. Hence the forest classification of these timber types was very broad, and very minimal ground sampling of these stands were carried out. Similarly the younger forests, age classes less than 80 years, had minimal sampling, as it was intended to sample them more intensely at the next reinventory. The lack of funding for reinventory until 1988 meant that this did not take place.

This lack of funding during the period 1980-87 meant the Forest Service could not carry out the planned cyclic reinventory, and could only manage inventory maintenance.

The situation changed in 1988 when funding was provided by the government to implement a reinventory program on a 10-year cycle. The program applies to both TSA's and TFL's. The program is intended to include periodic reinventory, GIS data maintenance and development, forest resource analysis, growth projections and inventory statistics.

The five-year (1988-92) budget for this new program is $13.5 million per year. Unfortunately the program has been under funded by about $1.5 million for the first two years, so the amount of field sampling planned has been reduced. Priority is

being placed on refining the classification of young forests, deciduous stands and special interest types by obtaining ground and photo plots in populations not previously sampled and in recompiling the upgraded sample database.

Methodology

Forest inventory procedures are complex and technical. We have outlined below the basic approach followed in British Columbia.

In the existing inventory, developed from the Unit Survey Program, land classification is based on airphoto interpretation. Two main classes are recognized: non-forest and forest land, and each one is further stratified based on it specific characteristics. For example, until 1978, forest land was classified as either mature, immature, not satisfactorily restocked, mature residual or non-commercial cover.

Mature and immature forest types were identified by species composition, age, height, stocking and site. The species composition listed the major species containing more than 20% of the gross volume and minor species containing 10-19% of the stand volume. Age was identified by 20 year classes, and heights by 30 feet increments, even for those stands with more accurate data. The stocking classes were broad; all immature stands formed one class, mature stands with less than 25% disturbance were put into two classes based on the number of stems per acre. Mature stands with up to 75% disturbance were classed as mature residual. Stands with greater than 75% disturbance or denuded by logging, fire, etc., and not meeting the minimum stocking requirements were classed as not satisfactorily restocked (NSR) and/or disturbed stocking doubtful (DSD).

The non-commercial cover designation identified mainly productive forest areas occupied by brush. Site class designations of good, medium, poor or low were used based on stand age and height relationships.

A stratified random sampling system was used for the management unit surveys. The mature forest types were aggregated into 42 inventory types, while the immature stands were grouped into 17 growth types.

Independent from the unit surveys, loss factors and volume table data was also collected and permanent growth sample plots were established in selected units to validate the loss factors.

A brief report describing the unit, the data sources, summary of area and volume statistics and the standard error of volume estimate was published for each unit.

This unit survey inventory program was based on a system of periodic re-inventories rather than on continuous inventory updating. The logging, fire and other disturbance history and land ownership status was current only as to the year of the field work.

In 1973 the inventory classification system was refined to identify areas requiring environmental protection. A classification system was developed to identify: areas with soil stability problems, regeneration constraints, avalanche and snow chute hazards, high recreational values and essential habitat for wildlife and fish.

The initial design of the sampling system was efficient and delivered the required information for management decisions. However, as management units were completed, the sampling design was not adjusted to include applicable samples from adjacent or similar management units. As a result, in some populations up to 1,000 samples were collected, while other aggregated types were not sampled adequately. Another major weakness of the sampling system was that the classification parameters did not explain the high degree of variation in volume within the aggregated types. Therefore, the increased number of samples had a beneficial effect only on the sampling error, but did not improve the capability of estimating the volume of individual stands. This was largely due to the broad class intervals on the parameters of the classification system, especially the stocking classes.

The sub-unit inventory system, started in 1977, introduced some major changes in classification, sampling and data analysis. In particular, the class intervals were abolished and the classification parameters were measured in continuous units. Species composition was recorded to the nearest 10%, age in years, height in metres and the stocking classes were changed to stems per hectare or to crown closure to the nearest 10%. Also, the sample design was changed to a multi-phase sampling combining large-scale photo samples and conventional ground samples. Site index of each stand was calculated from age and height, and volume was estimated through a regression equation with age, site index and crown closure or stems per hectare as independent variables.

The sampling system selected for the 10-year reinventory program is a multi-phase stratified random sampling, using large-scale aerial photo plots and ground samples with an allowable sampling error of ±10% at a 95% confidence interval. Since most of the province has been sampled previously, the sampling system is designed to take advantage of the existing inventory. In particular, the existing data was used to identify the strata which had not been sampled previously, such as second growth and deciduous stands or those that required additional sampling.

TREE FARM LICENCE INVENTORY

Introduction

Forest inventory of Tree Farm Licences is part of the management responsibility of the licence holder.

Very little information is available on the forest inventories of the first TFL's which were awarded in the late 40's and early 50's. For the most part, they were reconnaissance types of inventory, based on low intensity strip cruises, with volumes commonly estimated at the rough utilization level.

The TFL's awarded from the mid 50's and later inherited inventories completed by the Forest Service to the standards of the day.

The summary of Tree Farm License inventories is based on the 31 responses received to the questionnaire circulated to the 32 TFL's.

The questionnaire requested information to assess the standards and procedures used in the original or first inventory. The date of these first inventories varied, depending on the date of awarding the TFL. The TFL holder subsequently revised the inventory following Forest Service methodology and standards, but the field data collection was more intensive than was the practice for Crown lands.

These inventories provided the basic data for management of the Tree Farm Licences including:

- Calculating the allowable annual cut;
- Setting TFL management goals;
- Determining where to cut.

Even though the MOF provided funding assistance for TFL inventories, the inventory database was not given to the MOF. Currently plans are underway to ensure that all TFL inventory data will be acquired and maintained in the provincial database by 1992. Digitizing and database transfer in Forest Service format will be funded by the Forest Service, while the reinventory and field sampling will be at the TFL holder's expense.

Status

Based on the questionnaire and interviews, we have determined that all TFL's currently have forest inventories that equal or exceed the current Forest Service standards. The detailed summary of the questionnaires results are listed in **Appendix C.**

The latest available TFL inventories also generally follow Forest Service methodology and standards of the Unit Survey program. Volume sampling and validation of stand labels concentrated on the mature component of the inventory, immature areas usually have not been restratified in detail. For 10 TFL's that were reinventoried in the 1980's, the current Inventory Branch procedures for inventory have been used.

Only 18 of the 32 TFL's were able to provide information on the accuracy of their inventories, but all of these exceeded the MOF standards.

The majority of TFL's have annual or periodic updating procedures which appear to be up to date to 1988/89, based on depletion - i.e., recording changes due to logging, fires, regeneration, etc. In six TFL's, the immature component of the inventory was also stratified in greater detail during the update process. Out of 32 TFL's, 13 have GIS, 4 partially completed, 14 have no GIS, and 2 did not provide the pertinent information.

Identification and classification of environmentally sensitive areas, which were not covered in the original inventory, has also been done, to Forest Service standards. Seven TFL's completed ESA classification during the reinventory or inventory update process, and two more TFL's plan to carry out ESA classification in the next five years.

Recreation inventories are being compiled on 24 TFL's, fish and wildlife on 22, soils and ecosystems on 15, and range inventories on 10 TFL's. Other inventories that are being conducted on less than five TFL's are more site specific, such as mining, trapping, geotechnical, forest diseases and archaeological sites. Virtually no licensees have complete inventories for the whole TFL. Instead, the non-timber resource inventories are ongoing studies and are being conducted progressively, as necessary, usually for a complete drainage. According to the licence holders that have funded their own studies, the standards are in keeping with the appropriate agency standards. Seven of the license holders have stated that they have no plans over the next five years for non-timber inventories. The other licensees plan to update and upgrade existing inventories as necessary.

Methodology

The Tree Farm Licensees are required to carry out inventories to standards set and approved by the Forest Service. Most TFL inventories have followed the Forest Service procedures, although usually with a higher intensity of ground sampling. Some licensees (e.g., MacMillan Bloedel Ltd.) use approaches different than the Forest Service, exceeding in detail the Forest Service standards which provide more accurate stand level information.

The reported standard error of estimate for the TFL's on average is equal or lower than it is for the Forest Service Unit Surveys. It ranges from ±2.1% to ±10% at the 95% confidence level.

Inventory stratification and field data collection usually is contracted out to consultants; only a few licensees have the manpower and expertise to carry out this task. Database management, data analysis and preparation of inventory reports is carried out by consultants or their assistance to perform specific tasks, is used on a contract basis. Only the larger TFL holders handle this aspect of the inventory on their own.

LIMITATIONS

As the TSA and TFL inventories are essentially based on the same methodology, both have the same inherent limitations.

The forest inventory data relies on information collected by field sampling and estimates made from aerial observations and photo interpretation. However, the reliability of the forest classification depends foremost on the skill and experience of the classifier and his judgement. Although technical standards for classification and photo interpretation have been established, no formal certification of forest classifiers is required. This can result in variable quality of classification.

The existing forest resource inventory was developed during the past 25 years. The objective was primarily to produce inventory statistics by management units for the determination of allowable annual cuts. Consequently, the sampling system was optimized to provide average volumes that are reliable for a management unit but not for individual stands. This explains why sampling was concentrated on mature coniferous stands, and was very low for deciduous and second-growth stands.

In other words, the inventory was not designed to provide more detailed data for use at an operational level; e.g., harvest scheduling or stand-specific data.

Only when the classification system is refined to include the use of site index equations and adjustments are made for species compositions and realistic stand density or stocking estimations can stand specific volume estimates be derived.

COMMENTARY

The provincial timber resource has been the focus of the oldest continuous resource inventory throughout the province.

Until the mid-1970's, the latest available version of the provincial inventory was considered to be at an acceptable level. In the 1980's, the changing demands in the type of timber supply and the increased need for more emphasis on integrated resource management has shown up some limitations of the inventory. For example, there has been a rapidly developing demand from the forest industry to use deciduous timber as well as an interest in the commercial thinning of second-growth stands. Improved

integrated resource management planning requires more detailed data than the inventory has been designed to produce. Satisfying these needs requires finer forest cover stratification, more localized growth and yield functions to provide reliable stand level volume estimates, and new volume loss factors for second-growth stands. The provincial forest reinventory would likely have to double the present $13.5 million annual budget to achieve these requirements.

The inventory database is also used in timber supply analysis for the determination of allowable annual cuts. One of the reasons for the shortfall in timber supply is that not all the timber stands are accessible or available due to a variety of constraints. This problem is not a result of the inventory estimate but one of how the available inventory volume is netted for cut determination purposes. A more detailed planning process is required to provide a better estimate of the long-term supply available for harvesting in each TSA and TFL. Unless a process is developed to define the productive area required for timber production, the currently ever-increasing environmental and preservationist demands on the forest land base will continue to exacerbate the predicted shortfall in timber supply.

APPENDIX A

YEAR OF FOREST INVENTORY OF UNIT SURVEY AND ESA CLASSIFICATION

Year of Forest Inventory of Unit Survey and ESA Classification

UNIT NAME	YEAR INITIAL SURVEY	YEAR OF RE-INVENTORY	ESA*
Adams	1968		78
Aleza Lake	71		-
Alsek	75		-
Arrowhead	62	1977	77
Ashnola	69		77
Babine	74		74
Barriere	67		78
Barton Hill	70		77
Bell-Irving	73		78
Big Bar	62	76	76
Big Valley	69		78
Blueberry	64		78
Blue Mtn Forest	62		-
Botanie	70		77
Boundary	73,75		-
Bowron	67		78
Bow (unregulated)	67		-
Burns Lake	64	76	76
Canoe	74		74
Carp	73		73
Chilko	66		78
Cottonwood	69		78
Cranbrook	64		78
Creston	73		73
Crooked River	73		73
Dawson Cr. SSA	69,71		78
Dean	62,63,68		78
Dease	75		-
Dewdney	62,63	74	74
E&N Belt	70		-
Eagle	71		78
Edgewood	67	77	77
Fernie	63	73	79
Finlay	72		77
Fontas	69,70		78
Fort Nelson	68		78
Ft. St. James SSA	70		77
Furry Cr. SSA	70		77
Granby	67		77
Hecate	64,65		78
Kamloops	68	77	77
Ketchika	73		-
Kettle	63	77	77
Kinbasket	68		77
Kingcome	61,66,69,71	74	77
Klappan	72		-
Kluskus	65	75	75
Kotcho	70		78
Lac La Hache	72		77
Lardeau	69		77

UNIT NAME	YEAR INITIAL SURVEY	YEAR OF RE-INVENTORY	ESA*
Liard	1972,73		78
Longworth	71		77
Moberly	70		78
Monkman	66		77
Morice	72		77
Nakusp	67	1977	77
Narcosli	61,65	74	74
Naver	69		78
Nechako	62	75	75
Nahalliston	65	73	73
Nicola	61	70	77
Niskonlith	68		78
Nootka	69		78
North Thompson	67		78
Okanagan	64	75	75
Ootsa	65	76	76
Parsnip	65		78
Peace	72		78
Pr. George, SSA	63		78
Purden	67		78
Quadra	62,66-68		77
Queen Charlotte	67		77
Quesnel Lake	71		78
Raft	67		78
Rivers Inlet	68		78
Robson	74		74
Salmo	62	74	74
Salmon Arm	62	75	78
Shuswap	63	75	75
Sikanni	71		78
Similkameen	69		77
Skeena	61,62,66	76	76
Slocan	67	77	77
Smithers	61,66	76	76
Soo	64	75	75
Spallumcheen	72		77
Stikine	70		-
Stuart Lake	70		77
Stum	63,66		78
Sustat (TFL 40)	75		75
Takla	70,71		77
Taku	75		-
Upper Kootenay	65		77
Vancouver	70		77
Wapiti	69		78
Westlake	61	75	75
Williams Lake	73		73
Willow River	69		78
Windermere	61,68	74	74
Yalakom	65	77	78

* ESA: Environmentally Sensitive Areas

APPENDIX B

STATUS OF TIMBER SUPPLY AREA FOREST INVENTORY

Status of Timber Supply Area Forest Inventory

TSA		YEAR(S) BY SOURCE			
#	Name	DLE	IU	RI	REMARKS
1	Arrow	1984	1987		
2	Boundary	83	86		
3	Bulkley	85	88		
4	Cassiar				
5	Cranbrook		79,86		
6	Peace (old)				See #40 and #41
7	Golden	83-86			
8	Fort Nelson		80,88		
9	Invermere		80,88		
10	Kalum	86	85		
11	Kamloops		86,87		
12	Kispiox	86			
13	Kootney Lake		80,82,87		
14	Lakes	84	86		
15	Lillooet	86			
16	Mackenzie		88	1982	
17	McBride	84			
18	Merritt		82	79	
19	Mid-Coast			88-89	
20	Morice		84		
21	North Coast			79-82	
22	Okanagan			85	
23	100 Mile House	84	87		
24	Prince George	83-85	79		
25	Queen Charlotte		86		
26	Quesnel	81, 85-86	80		
27	Revelstoke	83-86			
29	Williams Lake	82-84	79,80		
30	Fraser	84,85	87		
31	Soo	86	88		
32	Quadra (old)				See #37, #38 and #39
33	Kingcome	82	82		
34	Nootka (old)				See #37 and #38
37	Strathcona			82	
38	Arrowsmith			88	
39	Sunshine Coast			87	
40	Fort St. John			89	
41	Dawson Creek			88,89	

TSA Inventory source:

DLE = Direct label entry (coded map label entry)
IU = Inventory update (detailed attribute entry)
RI = Reinventory (restratification on new photos)

APPENDIX C

SUMMARY OF TREE FARM LICENCE TIMBER INVENTORY STANDARDS AND STATUS

APPENDIX C

Summary of Tree Farm Licence Timber Inventory Standards and Status

TFL#	ORIGINAL INVENTORY Standards	ORIGINAL INVENTORY Accuracy	LATEST INVENTORY Standards	LATEST INVENTORY Accuracy	UPDATE ACTIVITIES SINCE LATEST INVENTORY	INVENTORY IS IN A GIS FORMAT
1	1949-1952: Photo typing. Strip samples. Intermediate to rough utilization. MOF compatible+.	N/A	1973-74: Close utilization. MOF compatible.	±10% @ 95% confidence level	1987 recompiled based on depletion update information. Complete reinventory planned for 1991. ESA classified in 1987.	No
3	Unknown	N/A	To 1981 MOF standards. Completed in 1983.	N/A	Inventory updated to Jan. 1/89	No
5	1948-1950: Reconnaissance. No details available.	N/A	1984-85: MOF compatible	N/A	None. (Update currently underway)	Yes
6	1958: Strip survey. Rough utilization. MOF compatible.	N/A	1979: Strip surveys. Coastal close utilization.	2.1%	Area summary revised to 1986, map revision to Jan. 1/89	Yes
8	1972: At MOF standards	±3.72% @ 95% confidence level	1983-85: To MOF standards	N/A	Currently being depletion updated to end of 1989	Partially
10	1951: Reconnaissance. Rough utilization. MOF compatible.	Unknown	1979: Close utilization. MOF compatible.	5.3% @ 95% confidence level	Annual updates. Second growth field surveying completed in 1988/89.	No
13	N/A	N/A	1981: To MOF standards	±10%	1:10,000 base maps updated in 1989 using 1988 photography and silviculture history	No
14	1952: Airphoto typing and ground strip surveys. MOF compatible+.	N/A	1983-86: To FS standards. ESA classification included.	Estimated to be ±10% @ 95% confidence level	Maps and data bases updated annually	Yes
15	1954-57: Strip survey w/photo typing. FS compatible+.	N/A	1975: To MOF standards	N/A	Data metricated. Area volume recompiled 1979. Maps digitized and updated in 1985. Database set up.	Partially

TFL#	ORIGINAL INVENTORY Standards	ORIGINAL INVENTORY Accuracy	LATEST INVENTORY Standards	LATEST INVENTORY Accuracy	UPDATE ACTIVITIES SINCE LATEST INVENTORY	INVENTORY IS IN A GIS FORMAT
18	1957-61: Airphoto typing. Strip survey. Rough utilization. MOF compatible+.	Unknown	1975: MOF compatible+. Close utilization level.	2.99% @ 95% confidence level	Converted to metric. Maps digitized and database converted in 1981-82.	Yes
19	1947-48: Rough utilization. MOF compatible.	N/A	1951: Close utilization. MOF compatible.	3.7%	Reinventory in 1986-89 in preparation for the upcoming MWP	Yes
23	1955: Airphoto typing and ground strip surveys. Close utilization. MOF compatible+.	N/A	1974: Classification to MOF standards. Prism plot sampling. Close utilization. MOF compatible.	N/A	* Annual update for disturbances. New reinventory underway to be completed in 1990; i.e. basically complete.	Yes
24	1952: Rough utilization	N/A	1985: Coast close utilization	1.7%	Area summaries updated to Jan. 1, 987. Maps updated to Jan. 1/89.	Yes
25	1962: Rough utilization and intermediate utilization	10%	1983-1988: Coast close utilization	1.4%	Some area summaries have been adjusted to Jan. 1/88. Inventory revision maps are updated to Jan. 1/89.	Partially
26	1955: MOF inventory	N/A	1988: To MOF standards and additional data and information	3.4%	None (recent inventory)	Yes
30	1966-1968: To MOF standards	N/A	Completed in 1989 to 1982 MOF classification manual specs.	N/A	Current to the end of 1987. Annual updates by GIS being developed.	Yes
32	Now part of TFL #49					
33	1962-1968: To MOF standards	±10%	1981: Using new MOF methodology	±4.5% @ 95% confidence level	Updated to Dec. 31/86	No
35	1962: To MOF standards	SE ±7.6% @ 95% confidence level	1978: to MOF unit survey standards	±5.29%	Periodic verification of type labels. History updated to Nov./86.	

TFL#	ORIGINAL INVENTORY Standards	Accuracy	LATEST INVENTORY Standards	Accuracy	UPDATE ACTIVITIES SINCE LATEST INVENTORY	INVENTORY IS IN A GIS FORMAT
37	1960: Strip cruise. Rough utilization. MOF compatible.	N/A	1983 MOF cruising standards for mature stands, close utilization	±5%	Ecological mapping. Immature inventory ESA classification. Site productivity correlation study.	Yes
38	1961: Rough utilization	N/A	1980: Close utilization	±4.5%	Annual update of denudation and regeneration. Immature surveyed in 1988-89.	No
39	1964: 1/4% intensity forest type level prism cruise. rough utilization. MOF compatible+.	1.2%	1964: Mature inventory. 25% reinventoried. 1979-84: To cutting permit standards. 1975+ immature inventory. MOF compatible+.	N/A	Periodic update to reflect changes. Inventory to Dec. 31/88. Will be completed early 1990.	Yes
41	1972-76: Airphoto typing and prism plots along strips. Close utilization (coast). MOF compatible+.	1.7%	Only the original inventory exists. No reinventory undertaken.	±5%	ESA classification to MOF standards (1988-89) added to the original inventory	No
42	No response received					
43	Kingcome and Homathko in 1960 and 1984 to MOF standards. Frazer in 1985 to Scott standards.	N/A	Kingcome reinventoried in '88 to MOF standards	N/A	None	No
44	1956: 1/4% intensity forest type level ground survey. rough utilization. MOF compatible+.	N/A	1978: Prism cruising. Coastal close utilization. MOF compatible.+	2.8%	Periodic update to reflect changes. Latest to Dec. 31/88.	Yes
45	Past inventories updated to Dec. 31/88 to MOF standards	15% at 95% confidence level	1981: In preparation for MWP	N/A	Updating for MWP's	Yes

TFL#	ORIGINAL INVENTORY Standards	ORIGINAL INVENTORY Accuracy	LATEST INVENTORY Standards	LATEST INVENTORY Accuracy	UPDATE ACTIVITIES SINCE LATEST INVENTORY	INVENTORY IS IN A GIS FORMAT
46	1968-71: As original TFL's 22/27. Additional cruises done. 1972-80: To produce current. 1982: Inventory to MOF standards.	N/A	1982: To MOF standards	±2% @ 95% confidence level	Periodic updating to document history of roads, harvesting and silviculture. Base maps metrified.	Partially
48	1969-72: MOF inventory	N/A	N/A	N/A	ESA classification by MOF in 1978. Annual update by MOF latest to Dec. 31/85.	No
49	1979, 83: MOF standards and procedures with minor local variations	±2.9% to ±6.5% depending on block #	Only the original inventory exists	N/A	Computerized database updated annually. Latest cut-off Dec. 31/88.	No
50	N/A					
51	1973: MOF standards using photography	N/A	1985: Office update from original inventory	Exceed MOF standards	1987 database for stand history. 1988/89 free growing surveys on 4500 ha. Trim mapping to be completed by May/90.	No
52	N/A					
53	Completed 1969 by MOF to Unit Survey Standards	N/A	None	N/A	ESA classification by MOF in 1978. Data files updated in 1982 and to end of 1986.	No
54	1956: By MOF	N/A	1969: To MOF standards	N/A	1987 reinventory of immature stands and complete reinventory of Seymour demonstration forest	No

APPENDIX D

SUMMARY OF TREE FARM LICENCE NON-TIMBER RESOURCE INVENTORY

APPENDIX D

SUMMARY OF TREE FARM LICENCE NON-TIMBER RESOURCE INVENTORY

TFL #	Other (than Timber) Resource Inventory	Next Five Years Plan for Non-Timber Inventories
1	Soil study Kiteen Block; Recreation and Landscape, Fish and Wildlife habitat	Soil and terrain mapping and wildlife habitat - Ishkeenich drainage. Biogeoclassification.
3	Recreation Inventory biogeoclimate map by MOF staff. Fish and Wildlife habitat to provincial guidelines	More detailed recreation inventory
5	Range, Soils, Wildlife, Recreation, Mining, Trapping studies only	No plans to expand these activities
6	Recreation, Ecosystem and Resource Folios to MOF standards. Fish stream classification and eagle nest survey.	Recreation and landscape sensitivity survey underway. Others will be updated as necessary.
7	From recce to detailed inventories conducted for: Fisheries, Wildlife, Recreation and Geotechnic. Dec. 31, 1981	Additional Recreational Inventories planned for 1990-91
8	CIL - Recreation, Soil, Wildlife capabilities. MOF - Range, Recreation, Water quality procedures used.	Not specified
9	See TFL #49	See TFL #49
10	Grizzly bear population and habitat inventory 1988/89	Recreation inventory underway. ESA classification will be conducted
14	Soil, Terrain and Biogeoclimatic inventory completed 1980-81. Recreation inventory was completed by FS staff.	None planned
15	Full ESA classification to FS standards including Fish and Wildlife (CIL) standards. Range and Biogeoclimatic data to MOF standards.	Current information will be improved and disease surveys and hazard ratings
16 17	See TFL #49	See TFL #49
18	Recreation survey to MOF standards in 1986. Terrain and slope maps 1982.	Unknown

TFL #	Other (than Timber) Resource Inventory	Next Five Years Plan for Non-Timber Inventories
19	Recreation, Fisheries and Wildlife range data to provincial standards (1988-89). Soils partially completed.	Soils as required. Wildlife to GIS format. Upgrade Fisheries data.
20	Partial by drainages of Fisheries, Wildlife, Soils, Recreation, etc. to standards acceptable to resource agencies	None
21	Partial by drainages of Fisheries, Wildlife, Soils, Recreation, etc. to standards acceptable to resource agencies	None
23	Full ESA classification and detailed Recreation, Landscape, Wildlife habitat and watershed inventories to the appropriate resource agency standards	Refining Wildlife inventory and updating Recreation inventory
24	Ecosystems completed for entire TFL, including soils, vegetation, stability. Landslide inventory maintained. Recreation identified.	None
25	Recreation ecosystems, fish streams, eagle nests, archaeological sites	Update existing inventories as necessary
26	Recreation 1986	Update and extension of Recreation data
30	Recreation and Landscape inventory presently underway. Fish and wildlife habitat capability maps provided by MOE.	Annual updates only
31 32	See TFL #49	See TFL #49
33	CLI data used for soils and wildlife. Recreation inventory compiled by other agencies.	None planned
35	Recreation inventory to MOF standard in 1986	Integrated Forestry-Fish and Wildlife plan
37	Recreation, Soils, Wildlife, Fisheries inventories as well as Forest Disease (Root rot, insects, etc.) inventories	Update Wildlife and Habitat inventories, as well as Recreational and Fisheries inventories
38	Recreation inventory in 1986. Resource folio and moose habitat study in Elako Watershed.	None planned

TFL #	Other (than Timber) Resource Inventory	Next Five Years Plan for Non-Timber Inventories
39	1974-83 Fisheries, Geotechnical, Soils and Wildlife inventories to various intensities. Recreation inventory also (less Blocks 5 and 7).	Recreation inventories for Blocks 5 and 7
41	Biogeoclimatic classification, MOF standard to subzone level (1989) (ESA classification - 3C)	Wildlife studies planned for selected drainages or parts of drainages
43	Fish and Wildlife - 1989	Recreation
44	Recreation and Terrain and Stability survey as well as Carmanah Report	Landscape inventory and Recreation update
45	Range, Slope Stability, Fisheries, Recreation, Stream	Updating Recreation and Landscape, Wildlife and Fisheries
46	Ecosystem, Streams, Biophysical, Deer Range, Recreation, Fisheries, Terrain	Recreation inventories of Rosemider and Walbran. Aquatic inventory for booming, Slope inventories.
48	Recreation and Range inventory completed by MOF	No specific plans, situation monitored
49	Biogeoclimatic classification and partial ESA on Block B. Recreation, Soils, Fish and Wildlife, Grazing and Water inventories assembled.	Complete ESA classification
51	Recreation, Landscape, ESA Classification and Streams funded by Westar	Wildlife
53	Utilized existing government branch information for recreation, wildlife and range, as well as obtained additional information	Recreation and Wildlife data update and other tasks will be performed as specified in the TFL document
54	1985 - Wildlife population and habitat inventory. 1978 - Soils survey.	Landscape inventory to be completed in 1990

WILDLIFE RESOURCE INVENTORY

SUMMARY

The Ministry of Environment, Wildlife Branch is responsible for conducting and maintaining an inventory of the wildlife species in the province. Hands-on wildlife management requires reliable data on animal population levels and trends, as well as knowledge of the kinds of habitats required to support the populations. Wildlife Branch is carrying out the inventory of wildlife populations and habitat capability separately, recognizing that each is a resource in itself, requiring specialist knowledge. Wildlife managers need good information on how many animals, the quality, quantity and distribution of various habitat, and knowledge on how the animals use those habitats.

There are 630 species of wildlife in the province. These include 143 mammals, 448 birds, 19 reptiles and 20 amphibians. Population inventory efforts have concentrated on the big game species; e.g, elk, mule deer, whitetail deer, moose, sheep, caribou and mountain goats. Limited efforts have been made for black bear, grizzly bear and wolves, and no inventories have been carried out for the fur-bearers and small animals. From our discussion with MOF staff, there is an obvious widespread dissatisfaction with the level of wildlife inventory information. Even with the ungulate species, for which the most data is available, adequate levels of operational inventory have not been achieved.

Habitat inventory is being carried out to classify and map habitat capability and to provide information to support resource management decisions to improve animal habitats. Small-scale habitat mapping of the province is completed. Larger-scale habitat unit mapping for regional planning is quite incomplete; e.g., of 1,100 maps needed to cover the province, 134 are partially finished.

Overall, the inadequate level of the provincial wildlife inventory is due to the ongoing lack of government funding for this program. The generally poor level of information available to wildlife managers means they are unable to adopt informed objective decisions when involved in integrated resource planning issues which will affect wildlife management. Wildlife are often forced to adopt a protective position, rather than approach an issue from a management perspective.

The MOE staff estimates an additional annual funding of at least $2.5 million per year is required for critical population inventory studies. Completion of the habitat capability mapping will require in excess of $12 million.

INTRODUCTION

The Ministry of Environment (MOE) has the mandate to protect the wildlife resource of British Columbia. According to the most recent available MOE Annual Report (1987/88), the goal of the Wildlife Management Program is "to manage the wildlife resources of the province for the benefit and enjoyment of the public, by maintaining an optimal balance between ecological, cultural, economic and recreational needs.".

The objectives of the program as stated by the MOE are to:

- Maintain and enhance wildlife and wildlife habitats, and thereby ensure an abundant, diverse and self-sustaining wildlife resource throughout British Columbia;
- Maintain, enhance and promote opportunities to appreciate, study and view wild species in their habitats;
- Maintain, enhance and promote recreational opportunities to hunt game species in their habitats;
- Facilitate commercial uses of wildlife;
- Protect people and their property from intolerable levels of danger, damage or harassment by wildlife.

Wildlife management requires both a knowledge of population trends and the habitat that supports the population. Each is a resource in itself and requires separate specialist knowledge and inventory. The inventories of wildlife population and habitat are dealt with as two sections in this review.

WILDLIFE POPULATION INVENTORY

Introduction

According to MOE personnel, no formal criteria have been established for a population inventory and most inventory efforts have focussed on providing information to deal with management issues at a regional level. There has been an ongoing shortage of manpower and funding to complete a comprehensive inventory. British Columbia has 630 species of wildlife; 143 mammals, 448 birds, 19 reptiles and 20 amphibians. The development of wildlife inventory procedures has concentrated on species of management concern. This includes big game species which are being managed to meet public demand for hunting and viewing, and monitoring of threatened and endangered species.

The goal of the population inventory is to provide reliable estimates of wildlife numbers and/or trends. The objectives of the MOE Wildlife Inventory Program are to:

- Bring species population levels up to levels of operational minimum to help determine if the program population objectives are being met;
- Provide a priorized listing of species for inventory evaluation and development that recognizes both cost-effectiveness and the sensitivity of each species to management actions;
- Develop standardized inventory methodology and reporting formats to ensure consistency and compatibility in inventory data regarding population size, trend and structure;
- Develop and implement standards for precision and accuracy in conducting inventories;
- Develop a computerized storage/retrieval system for population inventory;
- Develop monitoring programs for priority species within the various ecological zones of the province.

The MOE population inventory is being used to:

- Determine population status and establish realistic objectives for sustainable population levels;
- Determine sustainable population levels;
- Assist in co-ordinated land use planning (i.e. forest land-use decisions are held back until wildlife recommendations are made);
- Provide cost-benefit assessments of resource developments;
- Monitor population trends;
- Provide data input to assist the habitat inventory.

Status of the Inventory

The MOE achievements to date are:

- Standards have been set for the accuracy and precision of the ungulate inventories, such as deer, moose, elk, caribou, sheep and goats. (Inventory procedure guidelines and reporting formats for these ungulate inventories were not available at the time of the interview - *Reference #1*);
- A computerized ungulate inventory database is available for storing, retrieving and analyzing data;
- A computerized coastal water bird inventory database is also available;
- A list of wildlife species, tagged by colours red, blue and yellow, has been compiled for management purposes to indicate which are endangered, sensitive, and not at risk. This list is continually updated. (*Reference #2*);

- A list of population estimates and status as of 1987 for selected wildlife species (Refer to *Table IV-1*);

- A list of vertebrates of B.C., with scientific and common names has been compiled in conjunction with the Royal British Columbia Museum and the Ministry of Tourism, Recreation and Culture. (*Reference #3*);

The MOE wildlife population inventory is still incomplete. These gaps include:

- Most efforts have been directed towards ungulate inventory. With few exceptions, there has been little inventory of the other wildlife species (out of 630 wildlife species only 8 are ungulates). Even with ungulate species, adequate operational levels of inventory have not yet been achieved in most regions of the province. Monitoring of ungulate population trends has still not been adequately carried out;

- The population target levels for each species are being developed for the provincial wildlife species plans. These species plans are in various stages of completion, and the population target levels were not available to the interviewer as they are being revised. In the absence of reliable population inventory data, the MOE does not know if these targets are achievable or not. Little emphasis has been given to the long-term monitoring of ungulate populations, despite the fact the Wildlife Program has population objectives for most wildlife species;

- Presently, 40 species are considered to be at risk because of low population levels or vulnerable because of declining populations. The status of these species needs to be determined;

- Inventories are needed for carnivores such as wolves, grizzly bears and black bears.

TABLE IV-1

WILDLIFE POPULATION ESTIMATES AND STATUS, 1987
(Selected Wildlife Species)

SPECIES	SEASON	ESTIMATED NUMBER	STATUS
Endangered			
American White Pelican	Breeding	200-250	Stable
Burrowing Owl	Breeding	1 known pair	Fluctuating
Sea Otter	Spring	350-500	Increasing
Vancouver Island Marmot	Spring	200-300	Increasing
Large Mammals			
Black Bear	Fall	120,000	Stable
Caribou	Fall	13,000	Stable
Cougar	Fall	3,000	Increasing
Deer:			
• Black-tailed	Fall	200,000	Decreasing
• Mule	Fall	140,000	Increasing
• White-tailed	Fall	42,000	Increasing
Elk:			
• Rocky Mountain	Fall	35,000	Increasing
• Roosevelt	Fall	2,500	Stable to increasing
Grizzly Bear	Fall	12,000	Stable
Moose	Fall	170,000	Stable to increasing
Mountain Goat	Fall	55,000	Stable to increasing
Mountain Sheet:			
• Rocky Mountain	Fall	2,500	Increasing
• California	Fall	3,000	Stable
• Stone	Fall	12,000	Stable
• Dall	Fall	500	Stable
Wolf	Spring	6,000	Increasing
Birds			
Bald Eagle	Spring	15,000 adults 5,000 immatures	Stable to increasing
Trumpeter Swan	Breeding Winter	<100 <5,000	Increasing
Canada Goose	Breeding	30,000	Increasing
Peale's Peregrine Falcon	Breeding	200	Stable
Spotted Owl	Spring	<25	Decreasing
Barrow's Goldeneye	Spring	90,000-130,000	Stable
Ruffed Grouse	Summer	3-4 million	Fluctuating

TABLE IV-1 (cont'd)

SPECIES	SEASON	ESTIMATED NUMBER	STATUS
Small Mammals			
Badger	Summer	500-1,000	Increasing
Spotted Skunk	Summer	1,500-3,000	Increasing
Mountain Beaver	Summer	2,500-5,000	Stable
Deer Mouse	Summer	Several billion	Stable
Western Harvest Mouse	Summer	2,000-3,000	Decreasing
Beaver	Fall	400,000-600,000	Increasing
Marten	Fall	160,000	Stable
Muskrat	Fall	3,000,000	Fluctuating
Wolverine	Fall	5,000	Stable
White-tailed Jack Rabbit	Summer	0-?	Decreasing
Mountain Cottontail	Summer	1,000-2,000	Decreasing
Spotted Bat	Summer	30-60	Decreasing
Pallid Bat	Summer	<20	Decreasing
Fringed Bat	Summer	1,000-2,000	Fluctuating
Keen's Bat	Summer	1,000-2,000	Decreasing
Townsend's Big-eared Bat	Summer	2,000	Decreasing
Amphibians			
Pacific Giant Salamander	Summer	2,000-5,000	Decreasing
Tiger Salamander	Summer	750-1,000	Decreasing
Reptiles			
Painted Turtle	Summer	15,000-20,000	Decreasing
Short Horned Lizard	Summer	0-?	Decreasing
Sharptailed Snake	Summer	2,000-3,000	Decreasing
Western Rattlesnake	Summer	10,000-20,000	Decreasing
Gopher Snake	Summer	10,000-20,000	Decreasing

Source: Wildlife Management Operations, Wildlife Branch, MOE

Methodology

Most field inventories are conducted by Wildlife Branch biologists, but consultants are also used. Inventory methodologies vary by species and area, depending on what is the most efficient method of obtaining information on distribution, numbers/trends and population composition. As many wildlife species do not lend themselves to direct census (i.e., counting the number of animals on a given area), indirect techniques are used, such as biophysical capability mapping and population indices (e.g., number of deer observed per kilometre of road, number of wolves observed per day hunting, number of moose observed per hour for hunting). General population status is also determined from trapping and hunter harvest information.

The most reliable inventory is obtained for ungulates because population survey sampling methods are much more reliable even though many surveys lack estimates of precision and accuracy. Even statistically-based estimates, derived from sample-based surveys, have limitations related to the frequency of sampling, and resolution of the data. For ungulates, population estimates typically have a standard error that ranges from ±15% to ±30% of the estimate at a 90% confidence level. Since most of these surveys do not allow for sightability bias, the actual precision is less than indicated. Preliminary guidelines for the accuracy of ungulate inventories are listed in *Table IV-2*.

Population inventory has always been acknowledged as being weak or absent for many species and areas of the province. Radio-telemetry studies of ungulates have recently indicated that unbiased population estimates are even more difficult than previously realized, due to annual changes in distribution and behaviour, which confounds census results.

Carnivore (e.g., wolves) populations are counted by helicopter surveys because vast open tracts of land can be covered. This is only feasible in the northern part of the province where the large expanses of open land facilitate reliable tallying due to good visibility. A similar inventory technique is impractical in coastal areas because of the more densely forested terrain; thus the carnivore management program is hampered by a limited inventory.

TABLE IV-2

PRELIMINARY GUIDELINES FOR UNGULATE INVENTORIES LEVELS OF PRECISION AND ACCURACY

LEVEL			
1	90%	±10%	Inventory Development Population Research
2	90%	±25%	Intensive Management (Key Ungulate Areas)
3	90%	±50%	Less intensive management

Ungulates to be inventoried include

- Deer;
- Elk;
- Moose;
- Caribou;
- Mountain Sheep;
- Mountain Goat.

Source: Summary of Statistics, Wildlife Branch, MOE

Inventory of furbearers (e.g., martens, lynx) present logistical problems because the animals are very secretive and difficult to survey. Even the furbearers which are easier to count (e.g., beavers, muskrats) cannot be inventoried because of lack of funding.

Shortage of manpower and funding for conducting and evaluating inventories is also a problem. Geographical constraints such as difficult access and harsh terrain only compound the problem.

Limitations

All species surveys, without exception, could be improved with increased funding and staff support even though the inherent difficulties of elusive secretive habits, difficult terrain and forested habitats hinder the data collection. The extremely limited budget only worsens the situation. The increasing public environmental awareness means much more data and knowledge of the non-game species is required. This further increases the need for additional inventory funding.

Population estimates for many ungulates, carnivores, furbearers and birds are informed guesses, based on harvest levels and opinions of MOE regional wildlife staff. The estimated abundance of non-hunted species could be very inaccurate.

Improvements in aerial ungulate surveys will come from development of correction factors for methodological biases and optimizing sampling procedures. Additional research is required to make these improvements.

There is an inability at this point in time to measure the full impact of various resource development projects because of a shortage of manpower and funding. For similar reasons, the MOE is unable to react expeditiously to population declines, and introduce management improvement measures.

Population inventory is an ongoing management activity. The MOE is concerned that inventory information is still lacking for many species, particularly carnivores, furbearers, upland birds, reptiles and amphibians. The lack of inventory also continues to be a major problem in the management of threatened and endangered species, raptorial birds (e.g., eagles, hawks), waterfowl and ungulates.

WILDLIFE HABITAT INVENTORY

Introduction

Ecological classification and mapping done by the Wildlife Branch of the British Columbia Ministry of Environment is oriented toward identifying habitat for selected animal species, such as ungulates and bears. The emphasis on other animals is developing as requests for this information increase. This is being achieved through a program of biophysical mapping. The two main goals of biophysical mapping are (a) to provide a framework to assess the suitability and capability of the land surface for supporting wild animals; and (b) to provide a framework for improving animal habitats. The biophysical classification describes and maps areas that have relatively homogeneous climatic, physical (including soil) and vegetative characteristics of importance to animals.

The management objectives of the MOE Habitat Inventory section are:

- *Setting Standards*: Set standards for habitat evaluation through committee representation by publishing methodologies and guidelines and through workshops and presentations;

- *Mapping and Interpretations*: To map important habitat and provide ecologically based interpretations for the management of such habitats;

- *Inventory Research*: To conduct research to improve the identification of characteristics of important habitat, and as appropriate for method development for inventory and habitat management techniques;

- *Providing Expert Advice*: To provide technical and specialist advice related to wildlife and habitat inventory and land management for wildlife and environmental issues.

The inventory is designed to provide management information at the following levels:

Scale	Type of Map	Uses
1:500 000	Ecoregion/Biogeoclimatic Units	- Regional planning - Inventory stratification
1:250 000	Ecoregion/Biogeoclimatic Habitat Units and capability	- Broad scale planning - Census stratification
1:50 000	Habitat unit capability ratings for ungulates and grizzlies	- Subregional plans - Habitat protection - Selecting enhancement areas - Co-ordinated resource plans
1:20 000	Habitat Unit classification	- Operational planning - Habitat protection - Co-ordinated resource planning

Status

Habitat mapping that has been completed to cover the whole province includes:

- 1:2 000 000 Eco-regions (Regional Ecosystems), 1 map;
- 1:500 000 Regional Wildlife Habitat Maps (Ecoregions and Biogeoclimatic units, 15 maps.

Habitat mapping that is in progress includes:

- 1:250 000 Northern Biophysical Mapping (areas with limited access). Of 37 map sheets, only 10 are partially finished. These cost $100,000 per map sheet and will require $2.7 million to complete;
- 1:50 000 Standard Biophysical Mapping (areas with intense land use competition or management needs). Of 1,100 mapsheets the goal is to complete 600, of which 134 are partially finished. These cost $20,000 per map sheet and will require $5.3 million to complete;
- 1:20 000 Detailed Biophysical Mapping (areas required by policy or with intense management needs). Fifteen special areas completed, which represents less than 1% of the areas to be completed. The cost of completing this plan has not been determined;
- 1:5 000 Estuary Mapping, about 15 maps are completed which represents less than 10% of the estuaries. The cost of completing this has not been determined.

Methodology

The Habitat Inventory information is collected from 3 main sources:

- Literature and file searches;
- Interviews and consultations with staff biologists and other inventory specialists from other ministries;
- Field sampling.

Field crews usually consist of a pedologist, who interprets bedrock geology, surficial materials and soils; a vegetation ecologist who interprets climatic parameters, succession and stand characteristics; and a biologist who interprets current animal use and potential occurrence. All are responsible for developing habitat management interpretations. The greatest successes began when scientists from all three disciplines were present during field trips, agreed to the location of each plot and then simultaneously sampled the site. Interpretations and unit delineation were also best served when the same air photos were used.

Accuracy and Reliability

- Accuracy is related to scale of mapping and intensity of survey. Most of this information is based on reconnaissance level field inventory and air photo interpretation.
- Information is based on limited field work, that is usually collected over only one or two years; longer term data collection is much more desirable. Climate information is commonly insufficient as it is usually only represented by valley-bottom climate stations - no regional climate networks exist for most of the province.

Limitations

The habitat inventory mapping is used to express habitat capability values; i.e. the ability of the land to produce wildlife under its optimal successional state. MOE staff feels there is a need to describe what the habitat is currently able to produce (habitat justification). Given that so much of the habitat mapping is incomplete, there is a concern that integrated resource management is preceding without an adequate habitat inventory base.

COMMENTARY

Historically, there has been little need for a wildlife inventory. Game populations were not being markedly affected by human activities, and the supply of animals for hunting greatly exceeded the demand. Today, however, hunting pressure in many areas of the province exceeds the supply and there is a dire need to ensure that populations are not overexploited, either through harvesting or development.

Population inventory was originally directed almost exclusively to the ungulate group. According to the MOE, this was primarily to ensure that populations were harvested at sustainable levels and because hunting was primarily the main public interest. Now, however, there is an increased concern and awareness by the public to protect threatened and endangered species, and there is more pressure to manage the resource accordingly. Land managers also need more information on furbearers and small mammals, including rodent species, to improve forest management practices and land use allocations.

Forestry land use decisions are often delayed because of a lack of available data to make informed decisions. The MOE takes a protective stance due to the unavailable data, whereas a rapid decision could be made either way, if complete inventory information was available. Due to a shortage of staff, most studies are done on an ad-hoc basis.

The wildlife management goals are not necessarily achievable or measurable at present. They are used instead to provide general direction for individual activities. The need for reliable population inventory still remains as one of the Wildlife Program's greatest management requirements and a major funding initiative is needed to increase inventory activities. The wildlife manager needs to know how many animals, the

quantity and quality of various habitats and the distribution of those habits. A knowledge of how animals use these habitats is also required.

On the basis of comments from interviews with MOE personnel, an increase in staff employees to conduct the required inventories is necessary. These same individuals would compile the inventory data and prepare the final summaries and reports. It would provide the continuity in collecting the field data where consistent interpretative assessment is required to provide reliability.

It has been strongly suggested by MOE staff and also from other organizations that an integrated team of professionals from various biological science disciplines is necessary in order to conduct the necessary Habitat Inventories. The purpose of such a group would be to integrate experts from various fields, to encourage an understanding of the larger picture in order to help develop resource management.

Not all the 630 wildlife species will have population objectives. Species that are endangered or are being managed to meet public demand will have population target levels. The general order of priority will be the red list (endangered and threatened) followed by the blue list (sensitive requiring attention) followed by the yellow list (not considered at risk). At present, without a confirmed budget, it is not possible to priorize species within each list.

It is clear that a major increase in funding is required; but it is also imperative that if this is provided, then there should be a commitment by government to follow through with new wildlife management policies as a result.

REFERENCE MATERIAL

The sources of the above information came from personal, phone and questionnaire interviews with:

PERSONAL INTERVIEWS

MOE Wildlife Branch
- Bruce Penergast, Manager Habitat Inventory
- Dennis Demarchi, Habitat Classification Specialist
- Dan Blower, Ungulate Specialist
- Ian Hatter, Inventory Biologist
- Andrew Harcombe, Habitat Research Specialist

B.C. Wildlife Federation
- Charlie Cornfield

PHONE INTERVIEWS AND/OR QUESTIONNAIRES

B.C. Wildlife Federation
- Don Robinson, Board of Directors

Westland
- Mike Halleran, Journalist

UBC Forestry
- Fred Bunnell, Wildlife Biologist

LITERATURE REFERENCES

#1 MOE Wildlife Branch, Ungulate Inventory Database, Inventory Guidelines
#2 MOE 1989 Red, Blue, Yellow Lists (Species Status)
#3 The Vertebrates of British Columbia, Unpublished Wildlife Report, 1989.

Some profound quotes made by various interviews included:

- "How can land use decisions be made without an adequate inventory?"
- "Farm the work out to consultants."
- "Without the necessary information, everyone is dissatisfied with everything."
- "The main difficulty is defining how the resources are going to be managed."
- "The problem is time and shortage of money. There is no problem in finding people if they had the money."
- "Compromise is needed amongst the scientific types."

FISHERIES RESOURCE INVENTORY

SUMMARY

The Federal Department of Fisheries and Oceans (DFO) is responsible for the management of the fisheries resource in the province. In practice, they have limited themselves to managing the saltwater fishery (e.g., salmon, steelhead) and have delegated to the B.C. Ministry of Environment (MOE) the responsibility for the freshwater fishery (e.g., lake trout and bottom fish).

As there is a large degree of overlap by both Ministries in managing the fish habitat, a strong spirit of co-operation and communication has developed which prevents duplication in collecting inventory information.

Over the years, the DFO has collected massive amounts of data on fish populations and habitat data but have not developed a defined systematic approach to maintaining an updated inventory database for use by fisheries managers. A Stream Information Summary System has been developed and is in the process of being entered into a computerized database. Stream information from 3,500 streams supporting salmon populations in 42 subdistricts have been entered onto computer. To complete provincial coverage, information from 500 streams in 6 DFO subdistricts remain. There is considerable variation in the level of inventory information for each stream, which is dependent on the funding available for field surveys. DFO's main priority at present is to develop a fully computerized accessible inventory database. We were unable to obtain an estimate of the funding level required.

Like DFO, the MOE has assembled large amounts of fishery inventory data since field surveys were started in 1949. However, there has been inadequate funding to maintain an ongoing updated inventory program. Achievements include a reconnaissance level inventory of 20% of lakes and 10% of streams in the province, detailed inventory of less than 1% of streams, and fish species distribution, for most of the province have been delineated. Most of the existing data is not readily accessible, and has not been entered into a computer database or has not been updated.

At the present funding level the inventory information is unlikely to be completed at a regional or provincial level. Current efforts are focussing on entering the existing information onto a computerized database so that it is more readily retrievable.

MOE, Recreational Fisheries Branch staff recently estimated it would require an annual budget increase of about $3 million and 20-30 new staff to bring the inventory to an acceptable level.

INTRODUCTION

The Federal Department of Fisheries and Oceans (DFO) is responsible for the management of the fisheries resources in the province. In practice, DFO has limited itself to managing the saltwater fishery. Geographically, this means DFO has an interest in maintaining the fish habitat of all the coastal drainages and the major interior rivers and lakes systems that produce salmon and ocean-going trout; e.g. Skeena River and Babine Lake. Fish populations are being managed for both the commercial fishing industry and sportsmen. The responsibility for fresh water fishery has been delegated to the B.C. Ministry of Environment, Recreational Fisheries Branch (MOE).

Both ministries have collected considerable amounts of data and information on the fishery resource; however, an overall encompassing inventory covering the province has not been established.

The ministries, however, are co-operating in a Fish Habitat Inventory and Information Program. The overall goal of the program is to compile a comprehensive inventory of the quality, quantity and productive capability of fish habitats in fresh water, estuarine and marine environments of British Columbia.

For the purpose of this review, we have distinguished between the inventory activities of both ministries by preparing separate sections.

In view of the shared management responsibility, there is a large overlap where both ministries have an interest in fish and their habitat and therefore there is an inherent necessity for co-operation and communication to prevent duplication of inventory collection. The DFO decides on how many commercial fish can be harvested and sets sports fishing regulations, whereas the MOE ultimately decides how many fresh water fish can be harvested.

FISHERIES INVENTORY (DFO)

Introduction

DFO is compiling information for anadromous fish (e.g. fish that return to fresh water to spawn). The criterion used in developing the inventory is not well defined. The intent, however is to gather as much information as possible on all streams in the province with regards to fish and fish habitat.

The goals of the inventory are to:

- Provide a user-friendly computerized database containing fish population and fish habitat data at a summary level for all streams in B.C. and Yukon for use by resource managers in their planning;
- Provide a system for which information can be easily added or updated;
- Prepare thematic maps of selected fisheries information (base maps with certain themes) at 1:50 000 scale; and to eventually make the maps available on a Geographic Information System (GIS).

The purpose of the DFO inventory is to assist in:

- Initial screening of logging plans and other resource developments affecting fish habitat related;
- Providing an overview of production planning potential for fish stock management purposes by the DFO;
- Selecting streams for enhancement, restoration or management activities;
- Identifying streams for research studies;
- Providing fish habitat information to agencies, companies and the public;
- Preparing Stream Summary Catalogues for use by DFO and MOE for management purposes.

Status

The main achievements to date as related to us by the DFO are:

- The computerized Stream Information Summary System (SISS) has been completed. The SISS is designed to document all the existing fish habitat information available stream by stream. The system can be viewed interactively via a computer terminal, or as hard copy Stream Summary Reports for individual streams, watersheds and DFO subdistricts of MOE;

- Streams from 42 out of 48 DFO subdistricts have been entered onto the SISS, representing 3500 significant streams;

- All known streams which support salmon populations, and have documented information, have been entered on the system;

- The system can be accessed by direct link to a mainframe computer or by using a personal computer and modem;

- Mapping of selected thematic information has been completed for those locations where information on the computerized database exists.

The gaps that are left to be completed are to:

- Enter the 500 streams from the remaining 6 DFO subdistricts onto SISS;

- Enter MOE information for streams under their jurisdiction (i.e. freshwater fish and resident species);

- Eventually install a GIS for mapping of fisheries thematic information.

The DFO has plans in the future to:

- Develop watershed production plans; i.e. establish target escapement numbers for each stream to help determine baseline populations for planning purposes. (Escapement is the number of adult salmon returning to their home stream to spawn.);

- Priorize production planning (i.e. concentrate efforts first on the most productive and potentially productive streams and then to a lesser degree as the productivity decreases);

- Determine what fish and fish habitat information is insufficient for production planning purposes and collect the additional information through field surveys;

- Identify priority areas where development is occurring and is likely to occur so that the information will be available when required.

The DFO personnel we interviewed were reluctant to provide estimates of the costs to complete the above tasks as they are presently in discussions with MOE to finalize budget estimates. At present, they are arranging meetings to supply the pertinent dollar figures.

Methodology

An initial task of the Inventory Program was to compile existing fish habitat information on a stream-by-stream basis.

A Stream Survey Manual has been prepared which contains a detailed description of inventory approach, pre-inventory activities, field methods, data analysis and mapping.

The DFO has used three ways to collect fish inventory information, including:

- Field trips and stream surveys by federal and provincial fisheries staff. Information is recorded according to a detailed stream survey field guide (*Reference #1*);

- Observations from local residents on fish presence and use of stream habitat basis;

- Literature sources such as consultants' reports, personal memos and DFO and MOE reports and files.

The information that has been entered into the SISS and validated is considered by DFO to be reasonably accurate. However, while every effort has been made to verify information they do concede some inaccuracies may be present. The statistical reliability has not yet been determined.

It was foreseen at the early planning stages that there would be varying levels of inventory information collected depending on the location, accessibility and available funding. Not all streams have documented information even though they may support fish populations. DFO expects this situation will be remedied as the data collection process continues. Other streams have only minimal documented information due to limited field surveys which have been conducted on them.

Specific stream information is updated when new information for a particular system is obtained. Only certain individuals have update privileges within the region; some of these individuals also act as scientific authorities to validate any information added.

Limitations

In general, the fish inventory that is in progress is accomplishing the goals for which it was originally designed. However, it will become more useful at the subdistrict level once the information is accessible through a computerized database. More funding is required to train DFO staff in using the computer network.

The use of hand-drafted maps presents some difficulties when it comes to updating, but with the implementation of a GIS system, this problem will be eliminated. The DFO is in the process of reviewing the various GIS systems available and hopes to have a system installed by 1991. The DFO is co-operating with the MOE to ensure a compatible system is chosen.

The information gathering process is considered to be adequate, however, additional funding would allow a more thorough search of the information in certain areas.

FRESH WATER FISHERY INVENTORY (MOE)

Introduction

The MOE needs an inventory of the fresh water fishery to improve their knowledge of species distribution, biophysical capability for management, and value for protection purposes. However, due to a shortage of manpower and funding, MOE has been able to put in place an organized systematic inventory program. At present, information is collected on an ad hoc basis, for example, when required to comment on logging plans for a specific stream.

The MOE management goals for the inventory are to:

- Define the nature and extent of the fish resource, the habitat's capability and the physical susceptibility of the upland and riparian zone to damage that would affect stream quality;
- Evaluate the fish and fish habitat resources in a regional context for management priority.

The inventory information is used for:

- Protection of fisheries resources from other developments around the habitat including adverse logging practices, mining activities and abandoned mine tailings;
- Management (e.g. assisting MOE Parks Branch to determine if trophy fish exist in a specific river, logging plan inspection);
- Planning (e.g. how many fish can be caught in a particular lake, size of leave strips in logging plans, etc.);
- Assessment/evaluation (e.g. economic returns from fishing in the province).

Status

The goals that have been achieved by the MOE are:

- Approximately 20% of lakes and 10% of streams have received a reconnaissance level of inventory;
- A detailed inventory of less than 1% of streams that contain resident species of fish has been carried out;
- Inventory information for the major spawning streams for steelhead in the southern 1/2 of the province has been obtained;
- Fish species distribution in over 25% of the province has been delineated. This has been done largely by extrapolation and reasonable assumptions;
- A start has been made on priorizing management activities.

The major gaps that the MOE is attempting to complete are:

- Continued inventory collection of the above goals in a priorized manner;
- Priorization of water bodies regionally for management, protection and enhancement programs (e.g. priorize by road accessibility, angling use and impending development);
- Preparation of manuals to expedite and standardize the training processes of MOE staff for data collection;
- Transferring hard copy inventory data onto the computer information retrieval system;
- Access to a GIS. At present the MOE is planning to install a GIS for use by all branches.

A recent MOE study has shown that the Recreational Fisheries Branch would require an annual budget increase of $3 million and 20-30 full time employees to complete the inventory to their best ability.

The cost of a GIS and necessary software has not yet been determined.

Methodology

When conducting the habitat inventory the MOE follows the procedures outlined in the Stream Survey Manual and Stream Survey Field Guide.

The collection of fisheries inventory data varies greatly by the type of survey required and the budget level. Surveys are commonly carried out at a reconnaissance level and the detail varies, depending on whether it is for lakes or streams.

Basically, a reconnaissance level survey for a lake involves: using a boat for bathometry (measuring the contours underwater); using a net for fish sampling to measure species distribution, length and weight; and measuring water chemistry for the MOE Water Management Branch.

A reconnaissance level survey for a stream involves electroshocking (stunning the fish by means of an electric current) a defined small section of the stream to count how many fish are present. This count is then extrapolated to give an estimate of how many fish are in the whole reach (a specific stretch of stream with similar characteristics).

More detailed levels of inventory collection are only carried out when specific information is needed (e.g. if a major steelhead river is liable to be disturbed by a major development, then a detailed survey will be initiated).

Literature searches are done to minimize duplication of effort (i.e. consultants reports and surveys by other agencies). The MOE, working closely with the DFO in Vancouver, accesses its information first.

The accuracy of the information varies greatly by design (quick reconnaissance level for standard inventory vs. detailed reach inventory for specific developments), by virtue

of technical change and by budget restraints. The statistical reliability, therefore varies greatly due to the purpose for which it was collected.

Limitations

The limitations for MOE management applications are:

- Lack of easy access to the inventory information. Most data is in hard copy (in field note form as opposed to being entered in the computer) and hence it is very difficult to access information, compare it, and analyze it. The collection of enormous quantities of data was not envisioned when the inventory program was initiated back in 1949. As a result there is a huge backlog on hard copy data which makes quick retrieval of information very difficult;

- There is not enough data of the right kind at the right time (i.e. the data collected 25 years ago may not be adequate for today's needs and the very question of the reliability of extrapolation is in question);

- There are different expectations of inventory by different groups. Thus there is often a shortage of the "appropriate" information; i.e. there are very few common inventory solutions;

- Only about 15% of the lakes that were originally sampled have been reinventoried to provide data for a restocking plan (the reliability of the information collected 30 years ago is questionable);

- There is no procedure for direct inventory updating, it is done only as the need dictates (e.g. if there is planned development in a drainage the MOE often has a low level of information from which to assess habitat impacts;

- The inventory information is unlikely ever to be complete in a regional or provincial context. It can only provide an answer to a specific question at a particular time. Present budget levels make it unlikely that an overall inventory will be completed for the province.

COMMENTARY

There appears to be excellent co-operation between the DFO & MOE in the sharing of information and joint projects such as establishing the Stream Survey Manual). The DFO and MOE are at present jointly reviewing a suitable GIS. They are carefully analyzing the various possibilities and are conferring closely so that software applications will be compatible.

The MOE suggests that a systematic priorized approach should be used to obtain the information more cost effectively. At present, inventory tends to be collected in response to operational demands and often there is a duplication of effort. Better long-term planning is needed to avoid duplication of stream surveys. For example, considerable technical and cost efficiencies would be gained if fishery inventory could be scheduled with the long-term development plans of the forest industry.

The MOE also felt that interdisciplinary teams of specialists would produce higher value results. For example, a biologist, a terrain specialist and a fluvial processes specialist should schedule joint field studies to ensure complete data collection to reduce costs. Better communication amongst the specialists is essential.

A reasonable expectation of what the resources can produce must prevail to do the required inventory (i.e. how much of the resource can we use now and how much needs to be left in perpetuity for a gene pool, aesthetics, supply, etc.).

Data should be electronically recorded and appropriate hardware and software should be provided to manipulate the data sets.

The MOE personnel interviewed feel that as they lack the budget to complete the Fisheries Inventory, the budgeting sources should be examined. This might include cost-sharing with other resource users.

An issue paper is being prepared by the MOE emphasizing the high priority that the Ministry places on finding a way to improve the integrated resource management process in the province.

It is clear that an adequately funded inventory program is a key point of this process, and unless budgetary allowances are greatly increased, the whole issue of sustainable economic development is in question.

REFERENCE MATERIAL

The sources of the above information came from personal, phone and questionnaire interviews with:

PERSONAL INTERVIEWS

MOE Fisheries Branch
- Stu Hawthorne, Senior Habitat Assessment Biologist
- Ray Travers, Forestry Specialist
- Gary Norris, Senior Habitat Technician

Federal Fisheries
- Bruce Reid, Habitat Inventory Co-ordinator

B.C. Wildlife Federation
- Charlie Cornfield

PHONE DISCUSSIONS

B.C. Wildlife Federation
- Don Robinson, Board of Directors

MOE Fisheries Branch
- Geoff Chislett, Head of Habitat Protection Branch
- Peter Lewis, Head of Physical Processes Unit

LITERATURE REFERENCE

#1 Stream Survey Field Guide. June 1989. Department of Fisheries & Oceans and Ministry of Environment.

RANGE RESOURCE INVENTORY

SUMMARY

The Ministry of Forests, Integrated Resources Branch is responsible for the management and administration of cattle grazing on Crown rangeland within the province.

In 1987, there were approximately 2,150 grazing permits and licences authorizing 987,704 Animal Unit Months of grazing in the provinces. There is also an estimated 82 million hectares of potential forest rangeland within the province. The highest range use presently occurs in the Caribou, Kamloops and Prince George forest regions.

The administration of the range program has been handled mainly at the Forest District levels and the inventory data to assist the range manager has been weak. As there has been a growing number of emerging management issues within the range program, the Minister of Forests in 1988 ordered a Range Program Review. According to their report, published September 1989, there is no comprehensive range inventory. With respect to range inventory, the report recommended:

- Complete basic inventory mapping of boundaries and improvement;
- Develop a summary of range forage production capability;
- Conduct field mapping of ecological parameters, habitat and vegetation where required for specific management problems.

To date, 1,800 out of 3,200 1:20,000 scale maps have been entered into a computerized GIS database with range administrative and improvement information. The Ministry of Forests is co-operating with the Ministry of Environment, Wildlife Branch to develop standard procedures for field inventory to be used by both range and wildlife managers.

A Range Inventory similar to a Timber Inventory may not be feasible due to difficulties in delineating vegetation community boundaries (range types). Intensive sampling and statistical analysis is needed to determine whether or not forest cover types can be used as a guide to determine range types and what their respective forage capabilities may be.

Due to the uncertainty of defining range types and their capability, the Branch has opted for the monitoring of range use and effects of management tools, such as prescribed fire, on the range production. The Range Review Task Force recommended an increase in professional and technical staff to manage the range program.

INTRODUCTION

The Ministry of Forests, Integrated Resources Branch is responsible for the management, protection and conservation of forage, habitat and vegetative resources for use by livestock, wildlife and other uses of range resources. The range management mandate includes: maintaining range ecosystems to benefit commercial and non-commercial interests, promoting industries dependent upon range, allocating land between competing uses, deriving revenues for the province from commercial range users, administering a range tenure system and integrating range management with other forest resources.

The Range Inventory includes mapping range unit boundaries and structural improvements and interpretation of range productivity from forest cover, the collection of range biophysical data and vegetation surveys.

The objectives of the Range Inventory are to provide forest cover maps which depict up-to-date range administrative, improvement and vegetation information, as well as the collection and summarization of range vegetation data. These tools are necessary to assist the managers to be effective in range management and the planning of range allocation. The Range Inventory should be similar to that of the Timber Inventory which states how much, what types, where and what condition.

Three basic inventories are required to provide useful data to the rangeland manager. These are:

- Listing of administrative boundaries and the geographic descriptions of the range, such as a list of leases and pastures;

- Listing of range improvements which includes a summary and mapping of structures such as fences, cattle guards and water troughs;

- Listing of range ecosystems summarizing vegetation types and forage production capability.

Range administrative areas and types of range ecosystems are defined in Appendix A.

A Range Review Task Force was formed by the Minister of Forests in 1988. The initial reason for the Review was concern from ranchers over a proposal to increase grazing fees. The ultimate goal was to develop a strategic plan to guide range management priorities in the future. Its findings and recommendations were published in September 1989. Their report describes the state of the current Range Inventory. Resource users and managers from the public and private sectors participated in the review. Comments from this review have been incorporated into this report.

STATUS

The status of the Range Inventory can be described by the issues listed by the Range Program Task Force Review. The main issues identified are quoted below:

"There is a lack of clarification of the roles and responsibilities of Integrated Resources Branch and Inventory Branch staff with respect to range inventory activities."

"There is no effective and comprehensive provincial range inventory."

"There is no consensus on range resource inventory methodology."

"There is a need to complete range administrative boundary and improvement mapping, particularly in the Kamloops, Prince George, and Smithers Regions."

"There is a lack of standards and procedures needed for source map preparation and map updates."

"Databases of the Forest Service Inventory and Research Branches and the Ministry of Environment are not compatible."

From our interviews it is apparent that the Forest Service Executive has not provided the Range Program with its full backing. There is a lack of direction and limited funds which has hampered the progress towards a complete Range Inventory. We were told that there is a large amount of forest range information stored in files within the Inventory Branch of the MOF. This data is not easily accessible by the Range Program managers.

At present, a draft Range Inventory Manual which outlines the minimum standards and procedures for the collection and mapping of inventory data has been produced. It is not ready for distribution to the Forest Districts.

Broad forest types have been assigned to classify range types because seasonal and annual variability associated with forage production and species composition make an operational inventory of detailed range vegetation data difficult and extremely expensive. Information on these forest types is available in the forest inventory database.

Inventory and classification of these broad types has not been completed due to lack of manpower, other priorities or lack of funding to provide manpower.

Range production classes (kilograms of forage per hectare) have not been designed. An estimated accuracy or co-efficient of variation has not been designed to measure the variability of forage production.

A Range Habit Monitoring System has been jointly developed by the Range staff and the Ministry of Environment, Wildlife Branch to provide a cost-effective method to monitor the effects of management techniques and livestock use of range ecosystems. Because the collection of detailed range ecosystem data is difficult and expensive, the Range Section has opted to work with other agencies to monitor habitat response to specific management practices, such as prescribed burning. Within a range unit or pasture there are many diverse species of herbs, grasses and shrubs that are suitable animal forage. Completing an inventory, similar to that of the Timber Inventory, for the many forage species which occur on the estimated 8 million hectares of rangeland in the province would be extremely expensive. Hence, the Ministry of Forests range staff interviewed felt that an inventory of range forest types is not practical or necessary to achieve their mandate to manage range resources. Detailed forage inventories can only be done on very small areas. Valuable information on how range ecosystems react to management treatments as obtained by the Range Habitat

Monitoring Program will improve the Range staff's ability to make predictions on forage availability and select efficient methods to reach vegetation management goals.

To date, some 1,800 out of 3,200 forest cover maps on which range occurs in the province have been digitized with range improvement and administrative information. Out of the 1,800 maps, approximately 600 maps will have to be updated as new information is gathered. Regional Range staff is responsible to update maps in co-ordination with Ministry of Forests, Inventory Branch Computer Assisted Mapping (CAM) update schedules. The editing and updating of range maps will be an ongoing process in accordance with the Inventory Branch CAM update program. CAM updates, according to Inventory Branch, should occur every two years.

There is no vegetation-based inventory and the Range staff in the Forest Regions have no plans to carry out a field inventory until such time that they acquire inventory procedures. An interim non-field-based inventory is being developed. It involves producing colour-coded underlays which will highlight the broad forest range types on the forest cover maps. These underlays will assist in pointing out to resource managers the presence of range resources during the integrated planning process.

Future plans include working with the Habitat Inventory group of the Wildlife Branch to develop procedures for field inventory or range ecosystems to be used by both range and wildlife managers. The computer software to provide summaries of range vegetation is being developed. The IRM Branch anticipates that within a year summaries will be available on both the mainframe and the Geographic Information System (GIS) micro-computer systems used throughout the Ministry of Forests.

METHODOLOGY

Administrative information and range improvement data is drafted onto Forest District forest cover maps by the Forest District Range Officer. This information is located in Forest District and Region files, or in the personal knowledge of the Range Officer. Many Districts have old field maps which show lease and fence locations and which have notations describing range characteristics. The forest cover maps with range data are being entered into the provincial GIS system.

Broad range types based on existing forest cover types were included on the maps. Given the seasonal and annual variability associated with forage production and species

composition, an inventory detailing range vegetation communities is difficult and extremely expensive to acquire. For these reasons, the Range staff decided to develop descriptions of broad range types based upon groupings of existing forest cover types which were available from the forest inventory database. These broad range types are summarized on a number of administrative levels ranging from provincial summaries (see Appendix B) down to range units and pastures.

Further collection, summarization and mapping of the Range Inventory will be done in accordance with the draft Range Inventory Manual and the Habitat Monitoring Manual to be developed by the Integrated Resources Branch staff and the Ministry of Environment wildlife staff. These manuals are not completed at present and more guidance and funding is required to finalize them.

Administrative boundaries are accurate because they are related to lease descriptions and Forest District boundaries. These are tied to legal descriptions or physical features. These boundaries are plotted on forest cover maps as per the MOF mapping standards.

Range improvements have not always been accurately plotted on the forest cover maps. Improvements were usually sketched onto field maps and are often 100 to 600 m from their position as shown on forest cover maps. In the past, there was no need or concern to locate these improvements accurately. Today, interactions with harvesting require knowledge of where improvements are. Range improvement information storage is now being improved through use of the Range Improvement File System (RIS) which was developed and maintained by the Integrated Resources Branch. This system contains data on various types of fences and other structural range improvements.

One detailed Range Inventory project was partially completed in the Cranbrook Forest District. This project was cancelled due to lack of funding, the future expense to complete it, and confusion between the range responsibilities of the Range Program and the Forest Inventory Branch. Other smaller inventory projects are available only in the District in which they were done. This information will be incorporated into a provincial resource data file.

LIMITATIONS/USE

Presently, a comprehensive Range Inventory (similar to the Timber Inventory) does not exist. The projected use of the Range Inventory data is to provide assistance in planning the use of the range resource and to provide background range data to assist in integrated resource planning. Summaries of range improvements will provide background data on the use, maintenance and cost of established range improvement structures for budget purposes. Summaries of administrative area data will assist in the allocation of range resources to different users.

A lack of detailed information on the broad range types which occur throughout the province is a major limitation of the Range Inventory. More data and procedures for analysis of data needed to predict the amount of forage that can be supplied in these types and confirm the suitability of these types for livestock and wildlife use. The summary, as shown in Appendix B, of the broad range types indicate the presence of more range available than utilized which is misleading because not all these types are used as livestock range throughout the province. For example, lodgepole pine forests in the Cape Scott area on Northern Vancouver Island is not used for cattle grazing but is included in the inventory. The Inventory needs clarification on which broad range types are potential livestock range and which are not.

The boundaries of the vegetative community or range type cannot be readily delineated. Vegetation that constitutes a range type cannot be identified from timber types or aerial photos. Some photo interpretation can be done on open range types. Relating known vegetation sampling to timber typing is a complex mathematical and biological problem which current range research has not solved yet. Study may show that a range type inventory may not be technically feasible.

Because data on range ecosystems is not available, forage production estimates are not available for predicted land use by livestock. Prediction on forage available is conservative due to a lack of back-up ecological information on forage species and their response to weather and management practices such as prescribed burning. Range officers tend to be conservative in their estimates of available forage.

COMMENTARY

It should be acknowledged that a Range Inventory similar to a Timber Inventory may not be possible due to a lack of ability to delineate vegetation boundaries which would define range types. Intensive field sampling and statistical analysis may be required to establish a relationship between forest cover and range types. The end result may be that an inventory of range type may not be economically achievable.

With respect to the Range Inventory, the recommendations in the Range Program Review are:

> "Clarify roles and responsibilities of Inventory and Range Program staff for range inventory."
>
> "Reaffirm responsibility for range inventory to the Integrated Resources Branch as the Forest Service range inventory expertise resides there."
>
> "Provide basic inventory for all districts, with funding from Branch level for delineating:
>
> - Administration boundaries of stock range, range unit, pasture;
> - Topographical and natural barriers;
> - Local geographical names;
> - Structural and non-structural improvements, but not burning or seeding;
> - Known sample locations."
>
> "Provide detailed vegetation inventory on specific sites at the discretion of the local manager (funded at the local level)."
>
> "Provide procedures and use them."
>
> "Develop and share between Ministry of Forests and Ministry of Environment a common data storage and retrieval system for inventory and for monitoring."
>
> "Develop a contractor's list for detailed inventory projects."

These recommendations have resulted from consensus of opinion of the members of the Working Group Committee on Range Inventory and questionnaires considering range inventory for the 1988 Range Program Review Task Force. Representatives from the Forest Service Headquarters, Regions and Districts, Ministry of Environment, Ministry of Agriculture and Fisheries, Agriculture Canada, B.C. Wildlife Federation and the B.C. Cattleman's Association made up this committee.

To achieve the above recommendations, the Forest Service executive must set the types and levels of inventory required and then provide enough funding to ensure proper implementation. The present staff of District Range Officers cannot provide the proper level of range monitoring or inventory to manage and protect the resource. Staff reductions, through layoffs, transfers or by reduced access to staff under the pooled technician concept, have reduced the program's ability to concentrate on the resource. The day-to-day responsibilities for tenure administration (paper shuffling) have become the first priority. In some Districts, the Range Officers have dual responsibility; for example, range and protection or range and recreation.

Range Inventory as discussed in the Range Review should be the sole responsibility of the Range Section, Integrated Resource Management Branch. Past confusion between the MOF Inventory Branch and the Integrated Resource Management Branch has wasted funds and man-hours as well as making collected data unavailable to the range manager. Skilled professional range staff is required to assist the program.

During our interviews of range inventories we contacted the Range Section at headquarters, three Regions and ten Districts. Their comments ranged from "a fair inventory", to "Oh, I'm new here. The inventory data left in the head of the previous officer.". Comments such as these reveal the need for a standard, uniform, provincial inventory system. Time and money must be allocated to train staff in its use.

The Integrated Resources Branch staff in Victoria is concerned that too much emphasis will be placed on analysis of data rather than focussing on resolving resource allocation problems. Inventory is a tool to assist managers to make decisions. The level of data required must be set and then attained. This level must be adequate to provide information to the manager but not so high that all budgets are consumed to achieve that which may be unreachable.

APPENDIX A

DEFINITIONS

DEFINITIONS

Stock range: An area administered by a cattleman's association; e.g., Riske Creek Cattlemen's Association.

Range unit: An area within a stock unit that is defined by physical boundaries.

Pasture: A fenced area within a range unit.

Broad range types: As defined in the 1984 Forest and Range Report.

Alpine: The Alpine range type is typically associated with the Alpine Tundra biogeoclimatic zone and is dominated by low shrubs, grass and sedge species. Very stunted and shrubby forms of subalpine fir, Engelmann spruce, and western and lodgepole pine occasionally occur. Water is not as critical an element on these sites as it is in open range areas. Typically, annual rainfall is about 600 mm and snowfall about 400 cm. The soil on these sites is very sensitive to erosion because it is thin and the topography is usually rugged. The short growing season is a limiting factor in the ability of the range to produce forage. The grass-sedge communities at lower elevation alpine range provide an important source of late summer forage for cattle. These areas are fairly productive but must be well managed because over-grazing will quickly lead to accelerated soil erosion.

Ponderosa Pine Forest: The Ponderosa Pine Forest type is generally found within the Ponderosa Pine-Bunchgrass biogeoclimatic zone and is dominated by ponderosa pine with Douglas-fir. Grasses dominate a poorly developed shrub layer. As is the case with the Open Range Type, water is scarce and limits forage productivity. Rainfall is approximately 300 mm per year and snowfall about 100 cm annually. This type is important for the ranching industry. Primary use occurs during the winter, early spring and late fall. Typically these sites are potential producers of high quality forage. However, because they are so susceptible to degradation, grazing must be carefully managed.

Dry Forest: The Dry Forest type is generally associated with dry subzones of the Interior Douglas-fir biogeoclimatic zone and comprises a mixture of Douglas-fir and lodgepole pine, and to a lesser extent western larch and ponderosa pine. Pinegrass and associated forbs comprise the herb layer. Water supply is not a critical element in these areas. Precipitation is normally near 600 mm per year and snowfall about 300 cm. This type is primarily used as summer range. Productivity is good (averaging about 273 kg air-dry per hectare) but declines rapidly as the summer progresses. Adjacent dense forests provide good bedding cover. Because this type is moderately sensitive to disturbance, it should be carefully watched to prevent over-grazing.

Lodgepole Pine: This type occurs extensively throughout British Columbia in a number of different biogeoclimatic zones including Interior Western Hemlock, Interior Douglas-fir and Engelmann Spruce-Subalpine Fir. Water supply, particularly in areas located within the Engelmann Spruce-Subalpine Fir zone, is not as great a limiting factor as it is in the Dry Forest type. Summer gazing is of particular importance on these sites. Productivity ranges from zero at high stand density to about 550 kg air-dry per hectare at lower stand density. In some areas, burning and thinning are used to increase productivity. There is a great potential for wildlife/cattle conflicts in the Lodgepole Pine type as it is used extensively as wildlife habitat.

Wet Forest: The Wet Forest type is usually associated with the Montane Spruce and Interior Cedar Hemlock biogeoclimatic zones and is formed from a varied mixture of coniferous species. The predominant species are normally Engelmann spruce, lodgepole pine, subalpine fir, cedar and western hemlock. Water supply is not a critical element on these sites since rainfall generally averages about 700 mm annually and snowfall approximately 500 cm per year. Clearcuts are used extensively for summer grazing and dense lodgepole pine stands provide good browse. Because of the competition for browse, there is a substantial potential for conflicts between cattle and wildlife on these sites.

Deciduous Forest: This type, located primarily in the Peace River area, is the forest type which provides the best grazing because it has a rich understory. Both the herb and shrub layers are rich in nutrients and water is not a limiting factor. Forage productivity ranges to 1000 kg air-dry per hectare. Much of the summer grazing in these locations is carried out on cultivated community pastures.

Transitional: These locations are classified as either non-productive, disturbed or not satisfactorily restocked to a forest crop under the forest inventory system. The sites vary widely as to vegetative species and soil moisture, and their value as livestock grazing range varies accordingly. For example, in the Peace River area these sites are heavily used by livestock but the transitional areas in the Mid Coast portion of the province are non-commercial or non-productive types that do not provide any opportunity for grazing.

Clearings: These areas are typically associated with the Wet Forest type. The description of that type applies equally well to the Clearings type.

Non-Vegetated: This type supports only a very small livestock population.

Brush: The Brush type occurs ubiquitously throughout the province and varies widely in its potential for grazing but does not provide good grazing range in any area.

Alienated: Alienated land (private) provides much of the most productive grazing in the province, but because they are not under Ministry of Forests management, they are not included in this report in the estimates of utilized range.

Urban: The urban classification includes a wide variety of sites such as industrial areas, pipelines and power lines. Some of these may be seeded and can provide significant grazing opportunities. Others, where there is more intensive industrial activity, provide only limited use.

APPENDIX B

RANGE ADMINISTRATIVE AREAS AND TYPES OF RANGE ECOSYSTEMS

PROVINCIAL TSA TOTAL RANGE INVENTORY STATISTICS

NUMBER	SPECIFIC TYPE NUMBER	GENERAL TYPE	AREA (ha)	%	UTILIZED CROWN RANGE (ha)	% AREA OF TYPE UTILIZED	ACTUAL USE AUM
1	1	Open Range	341,736	0.4	221,232	64.7	122,293
2	2	Wetland	1,677,290	2.0	275,299	16.4	61,077
3	3	Alpine	24,040,843	29.0	277,400	1.2	17,394
4	14,15	Ponderosa Pine Forest	101,619	0.1	56,104	55.2	18,597
5	13,20,21	Dry Forest	3,663,635	4.4	1,228,399	33.5	206,219
6	16,17,19	Lodgepole Pine Forest	9,663,204	11.7	1,799,203	18.6	112,569
7	18,22-25,28,29,32-34	Wet Forest	21,791,475	26.3	630,398	2.9	19,121
8	26,27,35	Deciduous Forest	3,817,059	4.6	1,420,057	37.2	76,285
9	9,10,12,30,31	Transitional	8,610,723	10.4	1,894,299	22.0	185,075
10	4	Clearings	167,732	0.2	95,334	56.8	76,293
11	5,7	Non-Vegetated	2,611,092	3.2	6,251	0.2	180
12	8	Brush	1,848,142	2.2	386,882	20.9	19,246
13	11,6	Urban	127,563	0.2	32,045	25.1	9,773
14	36	Alienated	4,398,277	5.3	-	0.0	-
Unit Total			**82,860,390**		**8,322,903**		**924,122**

W/C - wet or cold forest. Taken from the 1984 Forest and Range Report.

RECREATION RESOURCE INVENTORY

SUMMARY

The Ministry of Forests, Integrated Resources Branch has undertaken to maintain an updated inventory of the recreational resource of Crown lands in the province.

The recreation inventory is designed to classify the Crown land into different categories and types of potential recreation use. It also includes the mapping of defined recreation features and a landscape inventory of areas with high scenic quality. All these features blended together provide recreational experience for a wide variety of users.

The MOF initiated this kind of recreation inventory in 1981 and by 1984 had completed a preliminary inventory of all the Timber Supply Areas in the province. Tree Farm Licence holders were also requested to carry out recreational inventories to MOF standards when preparing updated Management Plans. Of the 32 TFL's, 17 have completed recreation inventory and 8 are partially completed.

Although the provincial recreation inventory is considered complete, ongoing updating and reclassification of the first approximation is necessary. Recreation classification is a subjective assessment, based on defined criteria, and as such has no statistical accuracy.

A draft inventory manual was completed in 1988, and although the criteria for the initial inventory have not changed, the information and knowledge used for some of the initial classification has increased greatly.

At present, about one-half of the recreation inventory maps have been entered into a computer-based geographic information system. Once this is completed, recreational information can be displayed at any map scale. It will be more readily accessible and much more useful in land-use planning projects.

INTRODUCTION

The Ministry of Forests, Integrated Resources Branch has the responsibility under the Forest Act to manage the recreational resource on Crown lands. These lands include provincial forests, Timber Supply Areas, Tree Farm Licenses (TFL's) and all unalienated Crown lands. Both forested and non-forested lands are included. Because they take place on Crown land, recreational activities such as picnicking, hiking, ski touring, and kayaking are generally managed by the Ministry of Forests. Activities such as downhill skiing or organized camping are usually managed by private or municipal agencies.

The Forest Service Recreation Program recognizes the many diverse outdoor recreation activities which need to be provided for in provincial forests. These activities range from aesthetic enjoyment of scenery to the physically demanding challenges of mountaineering and kayaking to motorized activities such as snowmobiling and trail bike riding. The Ministry of Forests identifies and manages a full spectrum of recreation activities to provide an opportunity for B.C. residents and tourists.

The Tree Farm Licensees have the responsibility to complete and maintain recreation resource inventories for their licensee areas. The TFL licensee may use the Ministry of Forests' system or use another system that is approved by the Chief Forester of B.C. The inventory must contain the Recreation Opportunity Spectrum, recreation features inventory and visual landscape inventory.

The goal of the Recreation Inventory activity stated by the Ministry of Forests is "to provide land managers with background information on recreational features and potential recreational features on Crown lands." Information on the location, accessibility, sensitivity, type of recreational activity and time of year, for each recreation feature or value is recorded in the recreation inventory. The objectives as stated in the Recreation Inventory Manual are:

- Involve the public, other agencies and industry in the identification and evaluation of the recreation resource base;
- Identify, assess and record recreation resources in order to manage and/or protect them;
- Provide a basis for managing the use of the recreation resources.

STATUS

The Recreation Resource Inventory of the province identifies current recreational uses and demands. It also identifies natural or cultural features that could generate a recreational experience. Approximately 1.8 million people each year, according to Forest Service estimates, take advantage of the Forest Service's more than one thousand recreation sites and the thousands of kilometres of trails. Another 15 million user visits, according to the Ministry of Forests 1987-88 Annual Report, are dispersed over the provincial forest land. The trend of the estimated use of forest recreation sites and trails is shown in *Appendix A*. This Annual Report also states that the recreation sport industry contributes $1 billion to the provincial economy.

The Recreation Inventory was initiated in 1981 and by 1984 a preliminary inventory was completed. The recreation features and Recreation Opportunity Spectrum have been completed for all Forest Districts in the province and 26 of 34 TFL's. The original maps were compiled on 1:20 000, 1:50 000 and in some cases 1:100 000 scale maps by each Forest District and TFL Licensee.

These inventory maps have been transferred onto provincial maps at 1:2 000 000 scale, causing some generalization and loss of detail. The landscape inventory is still being compiled.

Future requirements include updating of original mapping to add new information and to revise the original data. The inventory maps are to be digitized into the Geographic Information System (GIS) of the Ministry of Forests.

Those TFL's and Forest Districts that have deficiencies in the preparation and use of recreation resource inventories will be brought up to standard. The knowledge that the Recreation Inventory is important in integrated resource management will assist in changing the attitudes of forest managers towards the significance of recreation. Lack of recreation information may delay approvals of cutting plans.

METHODOLOGY

Each Forest District collected the Recreation Inventory information from staff knowledge of the areas. Local recreation clubs, general public, tourism industry people, resource users and other government agencies such as Ministries of Tourism,

Environment, Parks, and Transportation and Highways, and municipal government were contacted for their input.

The Recreation Inventory is comprised of three components:

- Recreation Opportunity Spectrum (ROS);
- Recreation features;
- Landscape Inventory.

The Recreation Opportunity Spectrum (ROS) was originally designed by the U.S. Forest Service and was adopted by the Ministry of Forests to classify areas which provide similar recreational experiences and areas which show potential to provide similar recreational experience. The ROS delineation identifies the different types of recreation experiences that are available on Crown land. Combinations of recreational activities, settings and probable experience opportunities are classified into six classes. These classes range from wilderness to urban parks. A table showing these classifications can be found in Appendix B. This approach divides a district or region into recreation management units which indicate similar management prescriptions and will assist in the resolution of resource conflicts.

The Features Inventory is based upon subjective assessment of natural and man-made features that provide a recreational experience. Examples of natural features which are inventoried include biophysical features such as waterfalls, tide rips, alpine forests or old growth forests. Cultural features such as pastoral landscape, man-made features or cemeteries, and historic features such as monuments, rock art or historic trails are classified as resource features. The features are assigned a management class which describes how sensitive the feature is to outside influence and whether or not it requires special management considerations.

The Landscape Inventory involves a list and mapping of areas of scenic quality or visual sensitivity (e.g. dominant mountain peak, scenic slopes) which are visible from a highway corridor (Whistler Corridor), communities (Golden, Mount Seven), recreation site, trail or waterway (Inside Passage). These views are rated as to their sensitivity to change and their ability to absorb change without disrupting the original effect of the view.

The inventory accuracy and quality ranges from very good to poor. Lack of training and manpower in the collection of data has resulted in some data being sketchy or

cursory. The quality of the original work is proportional to the time and effort expended on it and the experience of the inventory classifier to properly interpret and apply the technical criteria. Roughly one-third is good , one-third is fair and the remaining one-third poor.

LIMITATIONS/USE

The Recreation Inventory provides land managers with information on what the public demands for recreation within the provincial forest land. The ROS Inventory allows a district, Timber Supply Area or TFL to be divided into recreation management units which indicate similar recreation management prescriptions and help rationalize the resolution of resource use conflicts. The Features Inventory assists in the preparation of detailed site-specific prescriptions and operational plans. It is useful in budget planning to forecast maintenance, costs and planning, and future recreation facilities (recreation sites, camp grounds, boat launches). The Landscape Inventory is utilized in the projection of the effect of forest harvest on scenic resources. All three components of the Recreation Inventory are used by industry to prepare development plans and by the Ministry of Forests at the referral stage of forest development planning.

The generalized large-scale mapping which was derived from the small-scale District maps is adequate to assist in the preparation of provincial overviews and province-wide predictions. Potential resource conflict areas can be identified for further indepth research.

The Recreation Inventory is not compatible with those of the Ministry of Environment and Ministry of Tourism, Recreation and Culture. These inventories need to be entered into a common computer mapping system and plotted on similar scales to demonstrate their relationship.

The Recreation Inventory data is presently for internal use only. The maps are still in draft form in each Forest District. A commercial quality printing is required before they can be published.

COMMENTS

With the advent of the shorter work week, the availability of more leisure time and the rising cost of long distance travel, more people are looking to the provincial forests for recreation. To develop correct decisions, the integrated resource manager must have accurate information on all the recreation resources. It is the Recreation Section's responsibility to mitigate potential negative impacts of resource utilization on the recreation resources. To do this, the forest resources that provide a "recreational experience" must be identified.

Recreation is a bona fide forest resource. It is becoming more and more an issue for the forest planner. The Carmanah Valley, Sulfur Pass, the Inside Passage and the Walbran areas are examples of land use issues where recreational use or wilderness interests are conflicting with other resource users. Through the use of resource inventories which illustrate their relative values, the resource manager will be able to identify potential conflicts and prepare a land use strategy.

Visual landscape sensitivity has far reaching effects upon forest harvesting. Highly visible areas include views from highways (Whistler Corridor) and communities (Mount Seven from Golden) or from a recreation site, trail or waterway (Inside Passage). Harvesting may not be acceptable to the public on highly visible areas. Where the landscape can absorb some change, harvesting could range from selection cutting to small clearcuts. In unseen areas, clearcuts may be more acceptable. All of the above scenarios could have a serious effect upon the allowable cut and therefore on the sustainable development of B.C. The visual Landscape Resource Inventory is very important. A complete and accurate assessment should be a priority for forest managers.

Resolution of local resource development issues will require integrated resource planning and public consultation to respond to public concerns. An excellent inventory is one of the tools that should be available to the land manager. In most cases, however, land use conflicts will be resolved by the politician. Hence, the ministries concerned with land use problems must have the best available information.

APPENDIX A

ESTIMATED USER VISITS OF MINISTRY OF FORESTS RECREATION SITES AND TRAILS

ESTIMATED USER VISITS OF MINISTRY OF FORESTS RECREATION SITES AND TRAILS[1]

ANNUAL REPORT YEAR	SITE[2]	TRAILS[3]	TOTAL
1980-81	1,116,822	188,000	1,304,822
1981-82	1,518,000	171,000	1,689,000
1982-83	1,648,000	200,000	1,848,000
1983-84	1,517,900	182,000	1,699,900
1984-85	1,219,000	295,000	1,514,000
1985-86	1,326,000	255,000	1,581,000
1986-87	1,308,400	499,600	1,808,000
1987-88	1,502,000	409,000	1,911,000
1988-89	1,410,103	431,688	1,841,791

1. Table obtained from Recreation Section, Integrated Resource Management Branch.
2. Based on samples taken at sites.
3. Estimate only.

APPENDIX B

RECREATION OPPORTUNITY SPECTRUM DELINEATION CRITERIA

RECREATION OPPORTUNITY SPECTRUM (ROS) DELINEATION CRITERIA

PRIMITIVE	≥8 km from primitive roads	≥5000 ha	Setting is essentially an unmodified environment. Evidence of humans would be unnoticed by an observer wandering through the area. Evidence of trails is acceptable, but should not exceed standard to carry expected use.
SEMI-PRIMITIVE NON-MOTORIZED	≥1 km from primitive roads	≥1000 ha	Natural setting may have subtle modifications that would be noticed but not draw the attention of an observer wandering through the area. Area has not been logged or subject to industrial activity or it has been rehabilitated (second growth) to a point that it is no longer readily recognizable as an industrial/logged area. Structures are rare and isolated.
SEMI-PRIMITIVE MOTORIZED	≥1 km from better than primitive roads	≥1000 ha	Natural setting may have moderately dominant alternations but would not draw the attention of motorized observers on trials, waterways, and primitive roads within the area (i.e. industrial or agricultural activity must not be noticeable to the motorized recreational user). Structures are rare and isolated.
ROADED RESOURCE	Within 1 km of better than primitive roads	No size criteria	Natural setting may have modifications which range from being easily noticed to strongly dominant. Resource utilization and modification practices may be evident. There is strong evidence of designed roads, highways and/or railroads.
RURAL	No remoteness criteria	No size criteria	Natural setting is culturally modified to the point that is dominant to the observer on a sensitive travel route. May include pastoral, agricultural, intensively managed resource extraction or utility corridors. Pedestrian or other slow moving observers are almost constantly in view of culturally changed landscapes. There is strong evidence of designed roads, highways and/or railroads. Structures are readily apparent and may range from scattered to small dominant clusters.
URBAN	No remoteness criteria	No size criteria	Setting is strongly structure dominated. Natural or natural-appearing elements may play an important role but be visually subordinate. Pedestrians and other slow moving observers are constantly in view of artificial enclosure spaces. There is strong evidence of designed roads, highways, streets, and/or railroads. Structures and structure complexes are dominant. This class is provided in city and municipal parks.

WILDERNESS RESOURCE INVENTORY

SUMMARY

In response to a growing public demand for the increased preservation of wilderness, the provincial Forest Act was amended in 1987 to allow the Ministry of Forests to designate and manage wilderness areas within provincial forests.

The Integrated Resource Branch, Ministry of Forests has defined wilderness as "an area of land generally greater than 1000 ha that predominantly retains its natural character and on which human impact is transitory, minor and in the long run substantially unnoticeable."

An inventory of wilderness areas commenced in 1988 by the Branch and the initial inventory mapping was completed by March 1989. Wilderness areas have been identified and assessed on an overview basis for the entire province, and the maps entered into a computerized Geographic Information System. A provincial scale map (1:2,000,000) detailing this basic inventory has been produced as a draft working copy. It is planned to add additional information to this first approximation of the wilderness resource and to produce a series of maps at a 1:50,000 scale to be used for wilderness planning and designation at a Forest District level.

Wilderness has a different meaning and interest to other government ministries also involved in resource management. An intra-Ministry Committee, the Wilderness Liaison Committee Working Group, was established in 1989 to describe a provincial strategy and map of protected (wilderness) areas. When completed, this first approximation will identify and bring together the interests of parks, wildlife, tourism, forest wilderness and ecological reserves, as well as information on mineral and timber interests.

It is an important step in co-ordinating and integrating resource interests at a strategic level. It will be extremely useful in defining potential land use conflicts and the effects of proposed resource developments in wilderness areas.

INTRODUCTION

An amendment to the Forest Act in 1987 recognized wilderness as a legitimate use of provincial forests. The Ministry of Forests was given the mandate and responsibility to consider wilderness in the integrated resource management of the provincial forests. The stated purpose of the wilderness program is to protect and maintain wilderness resources in relation to the other uses of provincial forests to provide maximum overall benefits to British Columbia. To do this, an inventory of lands capable of providing a wilderness experience was required.

In 1989, a discussion paper titled "Managing Wilderness in Provincial Forests," published by the Ministry of Forests, defined wilderness as "an area of land generally greater than 1000 hectares that predominantly retains its natural character and on which human impact is transitory, minor and in the long-run substantially unnoticeable." Wilderness is a distinct, composite resource with inseparable parts which include recreation, wildlife, heritage, and other values and their interactions.

Cabinet may formally designate wilderness areas. The Forest Act also provides for recognition and designation of wilderness in areas that have not been formally specified by Cabinet.

Commercial timber harvesting and permanent access roads are prohibited. Mining exploration, uses consistent with preservation of wilderness and any use permitted for that wilderness area by or under the regulations are allowed within a designated wilderness area.

STATUS

A wilderness inventory was initiated in March of 1988 by the Ministry of Forests, Integrated Resources Branch and the initial mapping was completed in March of 1989. Wilderness areas were identified and assessed on an overview basis for the entire province. The wilderness inventory has been reviewed for drafting accuracy and has been entered into a Geographic Information System (GIS).

A provincial scale (1:2 000 000) map has been produced in a draft working copy only. This map is intended to be finalized for public use. This map base is presently used as a foundation for the preparation of map overlays showing the projected condition of

wilderness resources under various assumptions, (i.e. timber development and mining development).

The wilderness inventory will have to be maintained to allow for changes in access development and in land status, (i.e. land alienation, park area reservation, or wilderness area formation).

The initial Wilderness Inventory covering the province is a first approximation. Information is required to determine the quality of possible recreational experience and the amount of present and future use of each defined wilderness area. Maps are being prepared to show the relationship of wilderness areas to economic regions, ecological reserves, Forest Districts, Timber Supply Areas, Tree Farm Licences, and areas within 160 km from major population centers. Summaries are also required to show what ecosystems are represented in wilderness areas, the recreation values present and the amount of net forest land base presently classified as wilderness. This is to be produced on 1:50 000 maps for use in each Forest District.

An overlay series of maps (1:2 000 000 scale) are now available in draft form for: wilderness areas, potential mineral developments, net forest land base, tourism capability, identified special areas (where known), wildlife and fisheries.

METHODOLOGY

Ministry of Forests Recreation Officers in each Forest District compiled the inventory. Initially, areas of 1000 hectares or more that had no industrial development were delineated on the forest cover maps. The Forest Service Recreation Features Inventory was then used to determine which wilderness areas have recreational values and identify those which are potentially capable of providing recreational values and experiences. The primitive and semi-primitive classes of the Recreation Opportunity Spectrum (ROS) were also used to assess the amount and distribution of the current wilderness resource. (ROS is a system designed by the U.S. Forest Service which was adopted by the B.C. Forest service to describe combinations of recreation activities, settings, and possible experience opportunities in recreation.)

The Inventory was drafted onto Forest District maps at 1:50 000 scale, then generalized to a provincial map (1:2 000 000 and 1:600 000 scales). Existing

protected areas including national and provincial parks, recreation areas, and wilderness areas were included on the maps.

A series of overlay maps (at 1:2 000 000 scale) has been made to show a provincial overview of areas that could become designated wilderness. This includes maps covering: Forest Site Capability, Wilderness, Recreation Opportunity Spectrum, Tourism Capability, Mineral Potential, Priority Wildlife and Fisheries/Wilderness areas, and Land Capability for Forests. These maps are available in the Ministry of Forests, Integrated Resources Branch office.

LIMITATIONS/USE

The Wilderness Inventory presents an overview of where wilderness exists at this time. The Wilderness Inventory maps are used to investigate the effect of wilderness preservation on the sustainable economic development of the province. The Wilderness Inventory maps were used as input to a provincial overview on protected areas which was drafted by the Wilderness Liaison Committee (WLC). The WLC has had representation from the Ministries of Parks; Forests; Environment; Tourism; Provincial Secretary; and Energy, Mines and Petroleum Resources. The WLC is to develop a provincial strategy and map of protected areas (wilderness-type areas). This process is outlined in *Appendix A*. This plan is presently on hold, pending ministerial comment.

The Recreation Features Inventory, which forms background data for the Wilderness Inventory, has inherent difficulties with the quality of its data collection. Ground checking and verification is required to investigate whether a noted feature is truly unique or significant, is presently used or that it will have a future demand.

The Ministry of Forests is currently digitizing the resource inventories of other ministries that have an effect on wilderness into a GIS system. A schedule of the work required and the information to be produced is included in *Appendix B*. The following summaries of available wilderness are included in the contract:

- Provincial;
- Forest Region/District;
- TSA/TFL;
- 100 mile radius from 11 major centers.

COMMENTS

An overall view of the location of wilderness in the province is presented on maps which are available in the Integrated Resource Branch. The present inventory will assist resource managers in distributing factual information to focus discussions on wilderness.

The related inventories of Recreation, Fisheries, Fish and Wildlife, Forest, Mining, and Tourism need to be entered into GIS so that they can easily be reproduced on comparative scales and accessed though computer in the districts. The wilderness overlay system maps are not yet available on GIS and need to be produced into a presentable form so that they can be used by ministry staff to present to government, the public, and other sections within the Forest Service. These would be produced on scales of 1:2 000 000 and 1:600 000.

The present inventory, as part of the land use overlay, is extremely useful to land resource managers as it highlights where present land use conflicts are and where future conflicts may occur. The inventory provides data on what type of feature is present and its potential significance as a recreational feature.

APPENDIX A

PROVINCIAL OVERVIEW ON PROTECTED AREAS

PROVINCIAL OVERVIEW ON PROTECTED AREAS

FIRST APPROXIMATION MAP

February 14, 1989

A 1:2,500,000 scale map providing an initial provincial overview on protected areas has been prepared and is attached. A 1:2,000,000 scale map is intended if this approach is acceptable.

This first approximation map shows:

(a) current protected areas (i.e. parks, recreation areas, wilderness areas); and

(b) current interests by various Ministries (except MOF) for protected area study in relation to mineral and timber resources.

This map is based on:

(a) the following current interests by various Ministries for protected area study:

- park interest areas;
- wildlife interest areas; and
- tourism interest areas (from tourism capability maps).

  MOF wilderness interest areas and ecological reserve interest areas to be included when available.

(b) the following resource interests:

- mineral interests (from maps on mineral potential and coal-bearing areas); and
- timber interests (from forest capability maps).

This first approximation map needs to be updated and revised as new information becomes available. For example, as MOF interests related to wilderness are developed and Park/Wildlife/Tourism interests are refined. Also, the MOF is preparing a map showing the Net Land Base supporting the Allowable Annual Cut which would refine the timber interest areas; and mineral potential information is continually being revised and updated. In addition, other interests such as hydro or range have not been considered at this time.

The first approximation map differentiates agency interests for protected area study by expected degree of mineral and/or timber resource interest as follows:

Colour	Category
Green	Current protected areas (i.e. national and provincial parks, recreation areas and wilderness areas)
Dark Blue	Agency interest for protected area study with probable high mineral interests and/or high timber interests
Light Blue	Agency interest for protected area study with probable moderate mineral and/or moderate timber interests
Orange	Agency interest for protected area study with probable low mineral and low timber interests

The information on the map can also be used to differentiate between areas with single versus multi-agency interest for protected area study.

PROVINCIAL STRATEGY ON PROTECTED AREAS

February 14, 1989

PURPOSE

To describe a provincial strategy and map on protected areas.

BACKGROUND

A proactive provincial strategy on protected areas (i.e., wilderness-type areas) will guide and coordinate individual Ministries in their land use planning and management. The proposed strategy is intended to help identify multi-agency interests and resolve conflicts regarding protected area land use issues. The issue of how to move toward a provincial strategy was introduced at the Wilderness Liaison Committee's (WLC) October 1987 public meeting with groups representing forestry, mining, environmental and outdoor recreation interests. At that public meeting meeting there was strong support for further discussions to take place, thereby creating expectations that a strategy would be developed with public and industry consultation.

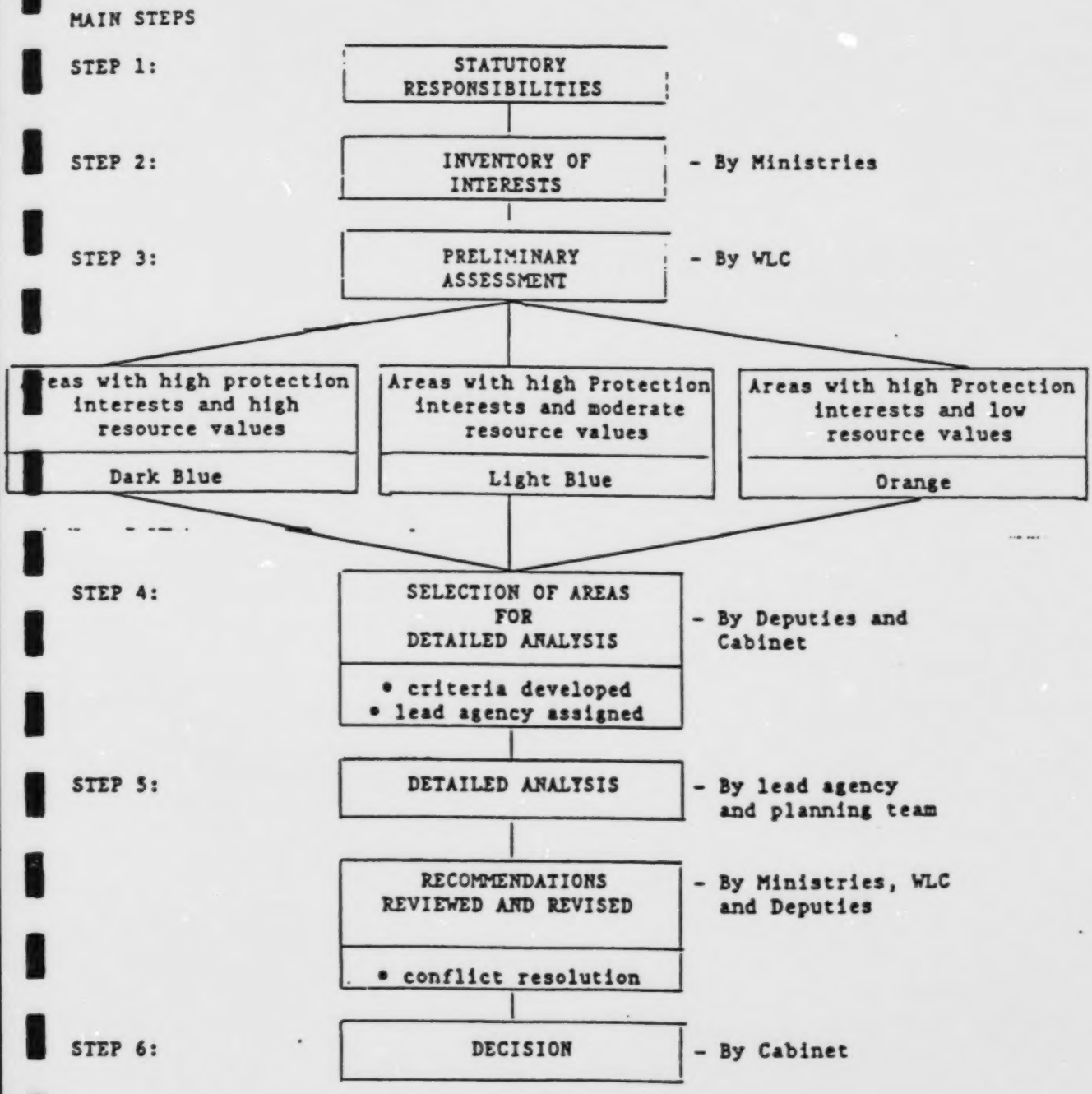
PROVINCIAL STRATEGY

The term "protected areas" is used instead of "wilderness" to avoid confusion with individual designation categories and to represent the range of such designations. With existing legislation, "protected areas" include, a spectrum of categories, from "fully" protected (provincial parks and ecological reserves), to "partially" protected (provincial forest wilderness areas and wildlife management areas). The proposed strategy involves the following main steps (see Fig. 1):

STEP 1: EXISTING STATUTORY RESPONSIBILITIES

PARK ACT	• Class A provincial parks and recreation areas
MINERAL TENURES ACT	• provides for time-limited mineral exploration in recreation areas
FOREST ACT	• provincial forest wilderness areas (mineral exploration permitted)
WILDLIFE ACT	• wildlife management areas
ECOLOGICAL RESERVES ACT	• ecological reserves
ENVIRONMENT AND LAND USE ACT	• used to establish Purcell Wilderness Conservacy

FIGURE 1
PROPOSED STRATEGY ON PROTECTED AREAS



STEP 2: INVENTORY OF INTERESTS

An integral part of developing a strategy on protected areas is an inventory of interests. This inventory includes both interests for protected area study as well as interests for other resources such as timber and minerals. The status of this inventory by various Ministries is summarized in Attachment #2.

Lands that appear to have significant values as protected areas have been, or are being, identified in various Ministry systems plans and by various public groups. This represents a general measure of "demand". A number of agencies are undertaking surveys and other studies designed to assess demand and value more directly.

STEP 3: PRELIMINARY ASSESSMENT

Areas identified in the inventory as "interest areas" will be preliminarily assessed by the Wilderness Liaison Committee for interests in protected area study in relation to other resources such as timber and minerals.

An initial assessment is shown on the map (attached) entitled, Provincial Overview on Protected Areas: First Approximation. This map differentiates agency interests for protected area study by expected degree of mineral and/or timber interest as follows:

- current protected areas (green);
- agency interests for protected area study:
  - with probable high mineral interests and/or high timber interests (dark blue);
  - with probable moderate mineral interests and/or moderate timber interests (light blue);
  - with probable low mineral interests and low timber interests (orange).

The information on the map can also be used to differentiate between areas with single versus multi-agency interest for protected area study.

The preliminary assessment, based on existing information, will need to be revised and reviewed as new information becomes available and would be done in the context of an overall land use strategy (if developed).

STEP 4: SELECTION OF AREAS FOR DETAILED ANALYSIS

Using the inventory and preliminary assessment, and with appropriate public and industry consultation, areas will be selected for detailed analysis. Detailed analysis includes both conducting appropriate studies and planning. This critical decision-making step will be done by Deputies and possibly Cabinet.

To guide this, it may be desirable to establish a provincial (interagency) goal statement on protected areas, such as: to ensure sustainable fish, wildlife and landscape resources, to protect special values, and to accommodate viable opportunities for recreation and tourism in balance with sustainable resource development.

Within the context of a Provincial goal statement (if adopted), the criteria for selecting areas for detailed analysis include factors such as levels of agency and public interest for protection; and interests for, and imminence of, resource development.

An appropriate lead agency and planning process will be assigned by the Deputies for each area where detailed analysis is to be undertaken. The level and type of public involvement will be determined as this may be critical to the success of the planning process.

STEP 5: DETAILED ANALYSIS

The assigned lead agency, normally either Parks, Forests or Environment, will coordinate a detailed analysis of priority areas in their appropriate region/district. This analysis will involve other agencies, licensees, Native groups and the public through existing Ministry resource planning and referral processes.

Detailed analysis includes the assembly and analysis of information for a particular area, the development of options and submission of appropriate recommendations. Recommendations will first be submitted to the appropriate Ministries, and the Wilderness Liaison Committee and Deputies, for review and resolution of outstanding conflicts (if possible).

STEP 6: CABINET DECISION

The reviewed and (if necessary) revised recommendations are then forwarded to Cabinet for decision.

SUMMARY

The provincial strategy, as shown on Figure 1, is the combined process of:

- statutory framework;
- inventory of interests;
- preliminary assessment;
- selection of areas for detailed analysis;
- detailed analysis (including recommendations); and
- Cabinet decision.

The strategy could be implemented in the context of an overall land use strategy and the setting of a target (see Attachment #1).

ATTACHMENT #1

ISSUES TO BE CONSIDERED IN IMPLEMENTING STRATEGY

1. Public involvement. Should the proposed strategy itself and the issues raised below be discussed with public involvement? If so, to what level? The WLC could report to Cabinet and seek direction on options such as holding public/industry meetings or developing a White Paper to discuss the proposed strategy and these issues.

2. Should the existing statutory framework, including nomenclature, be amended or not?

3. Should an overall land use strategy be developed to provide a context for this proposed strategy? The Wilderness Advisory Committee recommended that Government initiate an overall land use strategy for all Crown lands as a major vehicle for conflict resolution. This approach continues to be advocated by a broad spectrum of public groups, including recreation/environmental groups and the forest industry. An overall land use strategy, if developed, would guide and direct the proposed strategy on protected areas.

4. Should a target be set for additional protected areas? It may be desirable to include a specific target or reasonable upper limit for designated protected areas in order to:

   (a) alleviate concerns of the forest and mining sectors regarding the potential amount of protected lands;

   (b) indicate that government does intend to designate additional areas up to an identified limit which both reflects and sets public expectations; and

   (c) to provide direction to Ministries either involved in, or affected by, protected areas.

   On the other hand, a target that is set would inevitability be criticized by some as too much and by others as too little. More importantly, a target may also be viewed as not only arbitrary, but as pre-empting the planning process.

   The pros and cons of setting a target could be discussed with public/industry groups.

ATTACHMENT #1 - Page 2

If a target is chosen to be part of the strategy, what is a reasonable one? Approximately 6.3% of B.C. is currently designated as either national or provincial park, recreation area, or provincial forest wilderness area. By comparison, park/wilderness designations in Alaska are 22%, Alberta 10.5%, Washington 10%, California 10%; Idaho 7.5%; Montana 5%; Oregon 4%, Manitoba and Saskatchewan 2.5%.

A target of an additional 3.7% in B.C. would increase the areas designated to 10%. This, however, is not 3.7% alienation from mineral exploration, since mineral exploration is permitted in provincial forest wilderness areas. This is also not 3.7% impact on timber, because the majority of these areas could be expected to not have timber values.

ATTACHMENT #2

CURRENT STATUS OF INVENTORY

The inventory by each Ministry briefly described below is being revised and updated. Where the inventory includes identification of interest by agencies, an assessment has been built in by that agency based on their provinical objectives.

1. The Ministry of Parks has a systems plan indicating the areas that would meet their provincial objectives as a park. A similar approach is also being developed for ecological reserves.

2. The Ministry of Forests is now assembling provincial scale and regional scale inventory maps of currently unroaded and undeveloped natural areas and areas considered part of the Net Forest Land Base (upon which existing Annual Allowable Cuts have been based). The Ministry of Forests is digitizing this inventory on Geographic Information System (GIS).

3. The Ministry of Energy, Mines and Petroleum Resources has a provincial scale inventory showing areas of known high or moderate mineral potential based on preliminary and generalized information. The mineral potential of much of the Province, however, is poorly known.

4. The Ministry of Environment have developed a special areas inventory from a fish and wildlife perspective.

5. The Ministry of Tourism and Provincial Secretary is developing Tourism Resource Capability maps. These maps will serve as a basis for the Ministry to participate in provincial land-use strategies. Through various regional and sectoral interest groups, high value tourism areas will be revised and updated. First draft of maps has been completed, however, it contains only preliminary inventory and is thus incomplete. Second phase is underway and is expected to be completed by March 31, 1989.

APPENDIX B

SCHEDULE A

SCHEDULE A

RECREATION INVENTORY DIGITAL MAP PRODUCTION AND INFORMATION

The Ministry of Forests (MOF) will provide the contractor with the digitized information and attributes noted in Attachment 1. The contractor will use Terrasoft to:

1. Digitize, as a separate overlay, the 1:2 000 000 scale mineral potential map with attributes sorted as noted on map; and, once approved by MOF, produce mylar copy map with cross-hatching;

2. Digitize, as a separate overlay, the six 1:600 000 scale tourism capability maps, with attributes stored as noted on map and map attachment; and, once approved by MOF, produce mylar maps as noted in #9 (below);

3. Digitize, as a separate overlay, the location of "cities," and "major highways" as shown on the B.C. Roadmap and major lakes and rivers;

4. Digitize, as a separate overlay, 1:600 000 or 1:250 000 scale Net Land Base maps provided by MOF, with the digitized Net Land Base lines approved by MOF;

4A. Digitize, as a separate overlay, the 1:200 000 000 scale map of "Ecoregions of B.C.";

5. Correct, as requested by MOF, the recreation opportunity spectrum (ROS) and designated park/wilderness mapping and database;

6. Provide a unique attribute for each digitized TFL using appropriate TFL numbers provided by MOF;

7. Ensure all information previously provided and added is stored to ensure easy access for the purposes of generating maps, summary statistics, and further updating;

8. After a draft map is approved by MOF, generate map at a scale of 1:200 000 000 showing designated park/wilderness areas* and ROS/Net Land Base on mylar using cross-hatching, shading, etc. as

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* Ignore ROS classes within designated park or wilderness areas for the purpose of producing this map.

appropriate to ensure legible paper copies can be made with information on #3 (above) shown (but screened) for orientation;

9. After draft maps are approved by MOF, generate six maps at a scale of 1:600 000 and one at a scale of 1:2 000 000 showing tourism capability on mylar using cross-hatching, shading, on-site symbols, etc. as appropriate to ensure legible paper copies can be made with information #3 (above) shown (but screened) for orientation;

10. Provide summary statistics as noted in Attachment 2;

11. Design Terrasoft to allow additional map themes (overlays) and attribute files; and

12. Provide other summary statistics and services as required within the terms and conditions of the contract.

All maps, data, summary statistics belong to the province and are considered strictly confidential.

ATTACHMENT 2 - SUMMARY STATISTICS

I. The summary statistic format involves four separate reports for the following kinds of "areas":

A. Provincial Summary - for province as a whole.

B. Forest Region/District Summaries - for each MOF Region and each District within the Region.

C. TSA/TFL Summaries - for each individual TSA and TFL.

D. One hundred mile radius from 11 Major Population Centres - Vancouver, Victoria, Nanaimo, Kamloops, Kelowna, Smithers, Prince Rupert, Prince George, Fort St. John, Williams Lake and Nelson.

E. Ecoprovinces, Ecoregions, Ecosections.

II. All of the above reports will have the following two formats for each kind of "area" (from above):

	Km^2	% Area
A. Primitive* ROS Class		
• Semiprimitive Non-Motorized* ROS Class		
• Semiprimitive Motorized* ROS Class		
• Other ROS Classes*		
• Designated Park/Wilderness*		
TOTAL		**100%**

B. Total Primitive/Semiprimitive* Classes		
• In Net Land Base and High Mineral Potential		
• In Net Land Base and Moderate Mineral Potential		
• In Net Land Base and Low Mineral Potential		
• Not in Net Land Base and High Mineral Potential		
• Not in Net land Base and Moderate Mineral Potential		
• Not in Net Land Base and Low Mineral Potential		
TOTAL		**100%**

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* Ignore ROS Classes within designated park or wilderness areas for the purposes of these summary statistics.

TOURISM RESOURCE INVENTORY

SUMMARY

In its efforts to promote British Columbia's expansive natural beauty with a wide range of recreational and tourism opportunities, the B.C. Ministry of Tourism, Recreation and Culture has recognized the need to develop an inventory of the tourism-based natural resources in the province. The Ministry also sees the value in participating as an equal partner with other government ministries in integrated resource use decisions.

A Tourism Capability Mapping system has been designed to provide an inventory of tourism values. The classification is based on the recognition of four tourism zones, and is similar to the Recreation Opportunity Spectrum approach used by the Ministry of Forests. Classification work was initiated in 1987 and a set of draft maps was completed in 1988 covering the province. The inventory is not complete, as the draft maps are currently in the process of being checked and refined. When this is done, the maps will be entered into a computerized Geographic Information System, compatible with other ministries' databases.

The inventory information will be useful when assessing and planning tourism interests at an overview level; however, more detailed information needs to be collected on the various zones before the inventory can be used at a regional planning level. The Ministry is unable to update or revise this initial inventory, given its present budget levels. Basic data such as actual tourism use in days within the various regions and tourism zones of the province has not been collected. Without this basic data, the Ministry has to respond on an ad hoc basis to tourism and recreation issues within the province as they occur.

INTRODUCTION

In 1987, the Ministry of Tourism, Recreation and Culture (MTRC) recognized the need to obtain an inventory of tourism-based natural resources. The MTRC states that tourism is a natural resource-based industry, as well as a service industry.

A Tourism Capability Mapping system was designed to provide an inventory of tourism values. This system is similar to the Forest Service's Recreation Opportunity

Spectrum (ROS) as it identifies areas of present and potential tourism use. It provides a foundation from which the MTRC can become more actively and effectively involved in the provincial land use decision-making process.

A Tourism Features Inventory has also been done to identify values that create the "Super Natural B.C." theme used to market tourism in B.C. Tourism features are defined as natural wonders such as the Tseax Lava Flow in the Nass Valley or the Hope Slide and man-made features such as the Mica Dam or ski hills.

Through use of the Tourism Capability Mapping and the definition of tourism features, the MTRC provides other ministries with tourism resource information which can be utilized in integrated resource planning.

STATUS

In 1988, the first draft of the Tourism Capability Maps were completed for the entire province. These drafts, produced at a scale of 1:600 000, are presently in the process of referral and refinement. A final product is not available. This draft provides a provincial overview on tourism in the province and shows its relationship with other forest resources.

Present inventory plans of the MTRC involve gathering site-specific data on areas as the need arises. With the current levels of budget, the MTRC has no plans to redo the basic inventory for the whole province. Planning at this time is an "issue-related" reaction to conflicts as they occur. The MTRC is attempting to fill voids in the data received from other ministries; for example, a visual landscape inventory of the Inside Passage (Bella Coola/Prince Rupert) which is not available from the Ministry of Forests.

Future plans include investigation into the use of a computerized Geographic Information System to store and display information. The Ministry is presently re-examining its information requirements. The present Tourism Capability Mapping does not include enough information for detailed planning, therefore it will not be completed.

The MTRC is presently redefining its goals and methods of data collection. A user-emphasis style is being investigated; for example, what data is needed, the value of the

Inside Passage for tour operators or what data is needed to gauge the effect of a hotel development on an area. The MTRC has not estimated for budgeting changes or updates in the inventory.

METHODOLOGY

To prepare the first draft of the Tourism Capability Mapping, the MTRC employed a consultant to map out areas of tourism interest throughout the province. The consultant used his expertise, MTRC criteria and information obtained from the Wilderness Liaison Committee report, the B.C. Heritage Caucus and the Tourism Industry Development Subsidiary Agreement Regional Master Plans. A series of interviews was made with representatives of the Ministry of Forests, Ministry of Parks and the Ministry of Environment.

In consideration of the varied nature of tourism-related operations and their land requirements, a set of land zones was defined. These consist of groups of areas and tourism features which have similar characteristics and which require similar management approaches. The land zones criteria as defined in Appendix A include:

- Back-country/wildness;
- Mid-country/natural;
- Front-country/intensive;
- Urban.

The draft maps are presently in the regional tourism offices to be refined and updated. The general public, tourist operators and other ministries are being consulted for their input into the tourism resource.

The inventory is subjective and does not have a measurable statistical reliability. Values and reliability are dependent upon the ability of the consultant to properly apply the zonal criteria and portray the information received from the various sources.

LIMITATIONS/USE

The Tourism Capability Mapping is a valuable tool used to present the provincial overview of tourism interests. This mapping was considered by the Wilderness Liaison Committee, of which the MTRC was a full member, in the preparation of their land use strategy.

The allocation of land reserves for different types of recreation is an alternative use of the tourism inventory. For example, helicopter-ski areas and ski touring areas are identified in the inventory. Areas can then be assigned to each type of operator to ensure that each one has a supply of untracked wilderness.

The original mapping was done on large-scale maps. As tourism features data cannot be represented properly on large-scale maps, the Tourism Capability Mapping is inadequate for detailed local planning. Features such as small lakes or waterfalls cannot be located on large-scale maps.

The draft inventory requires updating as new information is acquired. For example, the first discussion paper on the Inside Passage only considered large cruise ships. New information has shown the increasing presence of small charter boat operators and kayak charters whose concerns and interests are different than those of cruise ship operators.

Because the inventory has not been entered into a computer mapping system, there are difficulties in comparing the tourism inventory with other Ministry inventories. For land managers to use tourism data, it must be easily accessible during the planning process.

Tourist-use data is not available at present. Each interest group keeps its own records or estimates of use; for example, National Parks has records of traffic through the park; B.C. Ferries Corporation has records of passengers. These records need to be researched and summarized by MTRC to show the significance of tourism on the provincial land base and the provincial economy.

COMMENTARY

To enable the formation of a provincial land use strategy, resource information for all ministries must be presented in a compatible form. All inventories should be entered into GIS.

The MTRC sees the value in being a full partner with other government ministries in integrated resource use decisions. The present overview on the tourism resource is an important tool in inter-Ministry decisions.

At present, the MTRC is not sure exactly what data it requires or how it is going to collect it. The MTRC will continue to investigate each resource conflict as it occurs.

APPENDIX A

TOURISM CAPABILITY MAPPING ZONE DEFINITIONS

TOURISM CAPABILITY MAPPING ZONE DEFINITIONS*

The definition of the zones designed by the MTRC to delineate the Tourism Capability Mapping are as follows.

BACK-COUNTRY/WILDERNESS ZONE

Provision to a smaller, though high-paying clientele, of high quality (often world class) wilderness experience in pristine unaltered environment characterizes this zone. Big game and fishing guide/outfitter operations, river rafting operations, photo safaris, nature treks, ski/mountaineering trips, sail charters, sea kayaking and horseback trips are associated with this zone. The absence of motorized vehicles and substantial lack of infrastructure are attributes of wilderness. The tourist experience emphasis is on landscapes which have not been altered by man.

Sub-Zones

High Capability - Preserved

Extensive (+5000 hectares) quality wilderness area already preserved as provincial park, recreation area, forest wilderness ecological reserve or national park.

High Capability - Unpreserved

Quality wilderness areas which, though currently unprotected, have been identified by government agencies and/or citizen organizations (MOF Recreation, Wilderness Canada Committee).

Other Wilderness Areas

Other extensive (+5000 hectares) areas which still remain in wilderness state but which are neither protected nor proposed for protection.

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* As obtained from the Ministry of Tourism, Recreation and Culture.

MID-COUNTRY/NATURAL ZONE

Tourism in the Mid-Country Zone is characterized by the provision of recreation experiences for "intermediate" numbers of visitors in a quality, wildland environment. Motorized transport (car, helicopter, sightseeing aircraft, motor boats, cruise ships) and smaller-scale facilities infrastructure (e.g. fishing lodges, resorts) are found in this zone in a manner that is compatible with the natural quality of this zone. Road access parks, quality fishing areas and scenic secondary or back-road drives are associated with this zone. Private lands are limited and even non-existent in areas of this zone, with commercial tourism ventures frequently operating on lease-hold Crown lands. The potential for conflict with other users is significant in this zone for this is where industrial forestry and mining activity predominates.

Sub-Zones

High Capability

- National/provincial significance (e.g. Inside Passage)
- Multiple tourism values
- Capability to handle larger number of tourism operations
- Accessible to urban areas and key aspects of the transportation network

Medium Capability

- Regional/local significance
- More remote from main transportation network and urban areas
- Individual rather than multiple tourism values and features

Low Significance

- Minor tourism values/features

FRONT-COUNTRY/INTENSIVE ZONE

The Front-Country/Intensive Zone services large volumes of tourists in a naturally scenic, though heavily altered environment. This zone emphasizes the valley bottom settled regions of the province. It is focussed on southern and coastal B.C. conjoined by major highway corridors. Tourism activities in the Front-Country/Intensive Zone will often be tied to motorized and high-volume transportation: buses, planes, trains, cars, gondola lifts. Tourism in this zone often involves the development of substantial infrastructures: destination resorts, motels, restaurants, shopping areas, entertainment services, tourist attractions, ski areas, etc.

Sub-Zones

High Capability

Areas around existing large-scale, large-investment tourism features; e.g. destination resort and ski hill hinterland. Areas where multiple tourism features coincide, or where features of outstanding tourism significance occur (international, national, provincial) would be represented by this sub-zone as well.

Medium Capability

Areas around small, moderate-investment tourism features, and/or features of regional tourism significance would be represented by this sub-zone. Most scenic highways would be included in this sub-zone (unless they were of such significance as to be afforded High Capability rating; e.g. Rogers Pass).

Low Capability

Other areas of the Front-Country/Intensive Zone of lesser tourism importance.

URBAN ZONE

The Urban Tourism Zone corresponds with the larger urban centres in B.C. (Vancouver, Victoria, Prince George, Kamloops, Kelowna, etc.) where a wide variety and intensity of tourism services are provided. Cultural-based tourism is the strongest feature of this zone. Typically, urban-based tourism is more dependent upon municipal land management decisions than provincial, thus it was not mapped.

WATER RESOURCE INVENTORY

SUMMARY

The Ministry of Environment, Water Management Branch is responsible for managing the provincial water resources in B.C. Accurate monitoring of the available water in the province is necessary to facilitate forecasting of water quality and water quantity for protection, operational decision making, and integrated resource management.

Water rights are related to estimated output of streams. Licencee requests are checked against records. If no records exist, then stream gauging will be done before a license is granted. The total quality of all licences must be less than the estimated low flow of the stream.

The Federal Government maintains daily measurement of inland water levels and flow rates.

From our discussions with personnel from the MOE, they appear to be obtaining adequate information to meet their objectives. The monitoring processes are continuing ongoing activities and therefore the concept of a complete water inventory can never be achieved.

There are 285 community watersheds containing Crown lands in B.C., covering a total of 11 287 km^2. These watersheds supply over 500,000 people or 21% of B.C.'s population with domestic water and therefore water quality and quantity are primary concerns. Other activities such as forestry and recreation take place within these community watersheds. Therefore, the development of resources within them will require both government agencies and licensed resource users to ensure a level of supervision and monitoring over and above that normally provided.

There are two privately controlled watersheds: Greater Vancouver, which is leased land and supplies 50% of B.C.'s population; and the Greater Victoria, which is mostly fee simple land and supplies 9% of B.C.'s population. Access on these watersheds is strictly enforced. Some timber harvesting is done on a controlled manner.

As pressures on the use of the water resources increase, increased monitoring of the resources is needed too, so that better planning for the future management of the water resources can be accomplished.

INTRODUCTION

The Ministry of Environment (MOE) is responsible for maintaining and protecting the water resources in British Columbia. That Ministry's Water Management Program has as its goal "to manage the provincial water resources to maximize the contribution these resources make to the social and economic development and well-being of all British Columbians.".

The objectives of the Water Management Programs, as stated by the MOE, are:

- A Water Management Program which is managed cost effectively through: planning; budgeting; fiscal control; program evaluation; asset control; effective communication systems; personnel system administration; administrative support services; technical support systems; and staff safety and training;

- Reduced potential for property damage and loss of life due to flooding and erosion by run-off forecasting, snow surveys, emergency action, regulation of flood plain development, implementation of flood and erosion protection projects, and inspection and maintenance enforcement for dykes and dams;

- Assured protection of licensed water rights and instream uses through allocation and regulation of the supply and use of surface water under the Water Act;

- An assured adequate level of water service to the public by privately-owned utilities by requiring works to appropriate technical standards; regulating water utilities; and providing technical support, including project management, to funding ministries;

- A high level of water resource quality for groundwater, fresh surface water, estuarine and coastal marine waters. It will be achieved through the establishment of resource quality objectives, water quality monitoring, watershed planning, referral and consultative processes, and assistance in the control of nuisance aquatic vegetation;

- An adequate information base on the supply capability of surface water and groundwater resources through the collection, storage and analyses of data;

- A high level of public health engineering support for the Ministry of Health through approvals and inspection of water supply sources, supply and treatment works, swimming pools and waste disposal systems.

Other uses of the Water Management Program are for:

- Forecasting for flood damage reduction (e.g. out of 182 municipalities in B.C., only one is not flood prone);

- Operational decision making by users of the water resource such as hydroelectric power, irrigation, domestic and municipal water supplies;

- Integrated resource management (i.e. an approach to managing resources where primary, secondary and other uses are compatible and normally results in continued production of all);

- Mediating in management decisions for reservoirs which act as multi-use areas.

The Federal Government, through Environment Canada, is responsible for maintaining a daily record of inland water levels. This federal agency maintains standard measurement of water levels of major lakes and flow rates and peak water levels for major rivers across Canada. Records in B.C. commenced in 1878 on the Fraser River at Mission. These records are considered as legal documents and have been used in court cases. The cost of this program is shared with each provincial government. The records are utilized by the Department of Fisheries and B.C. Hydro.

During the late 1960's, many public complaints were made to the government concerning a drop of water quality within community water supply watersheds due to resource use activities, particularly logging. This is perhaps inevitable since the province is committed to a policy of integrated use of the forest resources. In 1972, a Provincial Government Task Force was formed to review the following:

- Investigate the practicality of obtaining wholesome water supply from streams, the watersheds of which are subject to multiple use and;

- Recommend policy and procedures for management of land use conflicts within watersheds.

As a result of this review, the task force published "Guidelines for Watershed Management of Crown Lands used as Community Water Supplies" in 1980. These guidelines were intended for use by personnel involved in decisions regarding resource management activities on Crown lands within community watersheds. This is important because, in law, the onus to deliver high quality water to the consumer rests with the water purveyor (in this case the Crown is the purveyor).

There are 285 community watersheds containing Crown lands in B.C., covering a total area of 11 287 km^2. These watersheds supply an estimated 500,000 people with domestic water (*Reference #1*). Enforcement of regulations governing the quality and quantity of water within these community watersheds is carried out in close collaboration with the Ministry of Lands and the Ministry of Forests.

The Greater Vancouver Watershed and the Greater Victoria Watershed are two major privately controlled water catchment areas. As of July 1, 1986, these watersheds supplied approximately 1.4 million and 0.25 million people, respectively. Public access is limited and timber harvest is strictly controlled to areas where risk to water quality is minimal.

Table IV-3 shows the various types of water supply sources and the estimated percentage of the provincial population served by each source.

TABLE IV-3

DOMESTIC WATER SOURCES - BRITISH COLUMBIA

POPULATION	PERCENT TOTAL PROVINCIAL POPULATION	WATER SUPPLY SOURCE
1,205,000	50.3	Leased land (Greater Vancouver Water District
216,000	9.0	Owned land (Greater Victoria Water District)
221,000	9.2	Main Stem or large lakes
245,000	10.2	Wells, springs and miscellaneous individual sources
512,000	21.3	Community Watersheds
2,400,000	**100.0**	**Total, Province**

Source: Guidelines for Watershed Management of Crown Lands used as Community Water Supplier, Task Force 1980.

STATUS

According to MOE Water Management Branch personnel interviewed, the Ministry is achieving its management objectives. This is a continuous and ongoing process.

MOE Hydrology Section report states that a considerable amount of hydrometric data has been collected for the province. This data can be used to generate estimated mean annual run-off province-wide and for geographic basins.

Streams within large areas along the coast remain ungauged. Historical information on water levels and stream flows are missing in many instances and nothing can be done about that now. This emphasizes the importance of collecting and recording as much information as possible for future management purposes.

One cannot expect complete information on water resources because of the vast numbers of streams and lakes involved. It would require an extensive network of streamside gauges and monitoring systems, but basically the more monitoring installations in place, the greater the confidence in the water inventory.

The Greater Vancouver and the Greater Victoria Water Boards have excellent records of use and availability of water. The Vancouver Board has maintained records for 75 years.

METHODOLOGY

Data on the water resource in the 19 geographic locations and watersheds in the province is collected by monitoring snow depth, snow melt and run-off. A network of snow survey stations and streamside gauging installations is established throughout the province.

Run-Off

The greatest proportion of British Columbia's major river streamflow originates from the melting of mountain snow. Winter precipitation accumulates as snow on the mountainous watersheds, forming a reservoir, from which water is released to swell streams during the spring and summer run-off periods. Measurement of the water

contained in the snowpack prior to the commencement of melt is a good indicator of subsequent streamflow. This information is essential data for the agencies concerned with hydroelectric power, flood control, irrigation, and domestic and municipal water supply. In order to make run-off projections and sound recommendations, snow measurements begin as early as January 1 each year.

Snow survey stations are established at selected locations and elevations on major and tributary basins. The majority of these stations consists of a snow course only. Each snow course has 5 or 10 sampling points where a sampling tube is used to cut through the full snow depth; the depth is noted and the core is weighed. The average core weight indicates the water equivalent of the snowpack.

A few of these stations are equipped with snow pillows used to obtain a continuous record of snow water equivalent. Pillows in use in British Columbia are methanol/water filled, 3 m diameter, nylon-reinforced rubber containers. A sensing and recording device is attached to the pillow to monitor the pressure change created by the accumulation or depletion of the snowpack. Most of these pillows are now equipped to transmit data every three hours via satellite. In addition all but one of these, snow pillow stations are instrumented to monitor precipitation and temperature.

After water-equivalent measurements have been taken at the same sampling date for a number of years, a correlation is derived for a watershed by relating water equivalents and other applicable data to the subsequent streamflow. This relationship is used to forecast seasonal volume streamflow. These streamflow forecasts are published in the April 1 and May 1 bulletins, and are made with the assumption that precipitation and temperature patterns will be normal during the forecast period.

The daily temperature pattern during the snow melt period is the critical factor in determining maximum stages on major rivers. Only the very unusual combination of delayed snow melt, followed by a sustained period of high temperatures, causes flood-producing stages on major rivers.

Stream gauging stations are set up at 627 sites through the province for measuring the actual flow of water after leaving the snowpacks.

The accuracy of the computed basin results is highly dependent on the portion of the basin area that is gauged. Considering the long-term records of Water Survey of Canada published data, the accuracy of the results for the Fraser, Skagit, Columbia,

Peace, Liard, Taku, Stikine, Unuk, Nass and Skeena should be within 10% as most of the basin area is gauged. Accuracy for the remaining basins is variable and it is not possible to indicate how accurate the results are. As far as the provincial total is concerned, 84% of the total area is gauged and, as such, the accuracy of the total run-off should be within 10% (MOE Hydrology Section Report, 1986).

The following ***Table IV-4*** illustrates the estimated run-off for the 19 watershed basins in B.C.

The Greater Victoria Water Board maintains daily records of precipitation and water levels in each of the natural lakes and reservoirs that make up its water catchment area. Snowpack measurements are not taken because snow does not significantly contribute to Victoria's water supply. Each reservoir has a measured volume and is equipped with a gauge to record water levels. A depth volume curve provides an estimate of the amount of available water.

The Greater Vancouver Water Board uses snowpack measurements in each of its three watersheds to predict the potential volume of water to be available each summer. Vancouver usually has a surplus of water until July when precipitation decreases and snow run-off provides the majority of their water. Vancouver has 75 years of historical water records. The capacity of each reservoir is known and measurements of the water height on each dam allow the Board to record the volume of water available. Water used by the city through the water mains and water escapement for minimum creek flow is measured.

TABLE IV-4
BRITISH COLUMBIA ANNUAL RUN-OFF

BASIN	AREA $10^3 km^2$ (thousands)	MEAN ANNUAL RUN-OFF $10^6 dam^3$ (millions)	UNIT ANNUAL RUN-OFF Mean mm	High mm	Low mm
Fraser	234.2	120.8	516	607	425
Skagit	1.0	1.0	984	1 598	599
Columbia	105.2	66.9	636	745	499
Peace-Wapiti	125.8	50.2	399	501	297
Hay-Chinchaga	8.6	0.6	67	106	31
Liard	144.0	37.3	259	329	211
Yukon	24.7	13.0	528	610	419
Alsek-Skagway	11.1	10.2	922	1 100	761
Taku-Whiting	18.8	19.5	1 038	1 284	878
Stikine	49.8	46.2	928	1 091	774
Unuk	1.8	4.1	2 229	2 680	1 796
Nass-Bear	26.9	47.1	1 753	1 957	1 549
Skeena	56.5	61.2	1 083	1 267	941
North Coast	36.5	74.5	2 041	2 589	1 657
Mid-Coast (N)	16.2	36.0	2 227	2 872	1 785
Mid-Coast (S)	27.0	58.4	2 166	2 604	1 877
Lower Coast	15.6	37.7	2 409	2 845	1 844
Queen Charlotte Is.	10.1	27.5	2 731	3 163	2 226
Van. Is. & Gulf Is.	34.8	95.2	2 732	3 461	2 006
PROVINCE	**948.6**	**807.4**	**851**	**1 029**	**690**

km^2 = square kilometres

dam^3 = cubic decametres (10 cubic metres)

Groundwater

Out of approximately 60,000 ground wells in the province, 145 are observed on a daily basis to monitor the levels regarding extraction and rate of ability to recharge. Potability tests are also carried out at these locations to monitor man's activity in agriculture.

Quality

Sixty thousand samples are taken per year at 100 sites to measure against 40 pollutants (e.g. pulpmills). This is carried out by joint provincial and federal agencies.

The Water Management Branch is responsible for water rights licencing in B.C. The application date for each application is the priority rating for the licence. If the volume under application is lower than the estimated minimum stream run-off, the Water Branch may not require stream measurement before granting the licence. If there are other current licencees on the stream, then past records will be used to determine if there is enough water left over for the new licence. More measurement may be required. Estimation of low stream low flow is a judgement call based upon history, licencee knowledge and stream flow gauging. If records or measurements show that not enough flow is available, then the new licence will not be granted.

It should be pointed out that the methods of measurement are considered to be accurate and will improve as technology improves. However, the information is only accurate at the time it was measured because rainfall and snowfall, by their very nature, are constantly changing phenomena.

LIMITATIONS

The main limitation for water management purposes of the current information is perhaps the amount of missing data caused by equipment breakdown or malfunction during inclement weather conditions. Similarly, historic information has data gaps on water levels which cannot be rectified.

One Ministry opinion felt that instead of 627 stream sites for measuring waterflow 1,800 are really needed to get complete provincial coverage. At present, only the

heavily populated rural areas are measured. Other Ministry opinions, however, did not see a great need for this.

It is apparent from our interviews that more groundwater gauges are necessary to increase the confidence in that data collection. Not only is there a need for more gauges, there is also a need for the maintenance of these gauges over long periods. Short-term records of 10-20 years seldom satisfy the need.

COMMENTARY

In the opinion of the MOE Water Management Branch personnel, the management of the provincial water resources is adequate. As pressures on the use of the water resources are increasing, however, increased monitoring of the water resource is needed to provide more knowledge for the effective management of these resources.

The federal government has accepted responsibility for the major effort in stream gauging and therefore there is a need for more funding not only by the province, but also by the federal government. There is also a need to increase our knowledge of the impacts of logging in specific drainages by continuing the funding of the well-published experiment on the Carnation Creek Watershed Study.

Water quality and quantity are the primary concerns in community watersheds. On the other hand, the timber and recreation resources in these same watersheds should be safely incorporated into an Integrated Watershed Management Plan. Therefore, it is generally in the public interest that community watersheds be managed for the production of both water and timber as well as for other natural resources. However, such management must be guided by comprehensive planning that will not only identify integrated use potentials and opportunities, but also define the management conditions required to ensure compatibility.

REFERENCE MATERIAL

The sources of the above information came from personal, phone and questionnaire interviews with:

PERSONAL INTERVIEWS

MOE Water Management Branch
- Don Kasianchuk, Director of Water Management
- Don Reksten, Head of Watershed Studies
- Jim Mattison, Manager of Licensing Section
- Sandra Smith, Head of Planning Section

PHONE DISCUSSIONS

B.C. Wildlife Federation
- Don Robinson, Board of Directors
- Charlie Cornfield, Director

UBC Forestry
- Doug Golding, Hydrologist

LITERATURE REFERENCE

#1 Guidelines for Watershed Management of Crown Lands used as Community water supplies.

A SUMMARY OF TECHNICAL REVIEWS OF FOREST INVENTORIES AND ALLOWABLE ANNUAL CUT DETERMINATION IN BRITISH COLUMBIA

Prepared for:

THE BRITISH COLUMBIA FOREST RESOURCES COMMISSION
Victoria, B.C.

Prepared by:

HST CONSORTIUM
Richmond, B.C.

September 1990

EXECUTIVE SUMMARY

This review was initiated by the B.C. Forest Resources Commission (FRC) to investigate mounting concerns about the reliability of timber inventories and the resultant determination of annual allowable cuts. Over the past year, the FRC has conducted province-wide hearings and invited submissions by individuals and organizations. During this process, FRC Commissioners frequently heard, among many other statements, that the forests of the Province are being overcut. Many of the issues presented to FRC were stated in concert with a concern about the accuracy and reliability of the forest resource inventories in the Province.

The current provincial Timber Supply Area timber inventory data base was developed on a sampling design from the early 1960's and sample plots established primarily from the mid 1960's to the mid 1970's. This timber inventory was adequate for the level of use intended when it was designed; it is not considered adequate for today's needs. The study concludes that the current timber inventory has become outdated and is weak in several specific areas. Both the Ministry of Forests (MOF) and other users have been applying these inventory statistics beyond their limits of reliability.

Most Tree Farm Licence timber inventories tend to be more recent and provide more of the detailed data required for today's needs. Some Tree Farm Licence holders have been very active in developing "localized" inventory data, resulting in more reliable yield analyses and timber supply projections.

The current MOF Re-inventory Program is not addressing a number of the existing deficiencies in the timber inventory. The review concludes that the current design and emphasis will not make a significant improvement to the accuracy of the existing timber inventory database.

There is a significant lack of growth and yield data available for the commercial tree species within the Province. This impacts directly on our ability to understand how the forests grow and what yield can be expected. This situation must be corrected as soon as possible. Sound forest resource management planning is severely jeopardized by the lack of data for predicting both natural and managed stand growth and yield.

The copious amounts of data required for forest management decision support is not supported in the MOF by an adequate data management quality control system. Currently, data errors are easily introduced, time consuming and costly to reconcile. This situation is in need of immediate attention as there is an increasing number of users of the data outside of the MOF.

The report suggests several improvements that should be made to the forest resource inventory design and sampling processes. These improvements will provide a more reliable information base to plan and execute sound, environmentally sensitive, sustainable forest resource management.

The report has concluded that the required MOF yield analysis process has been meticulously followed for both the Timber Supply Areas and the Tree Farm Licences examined. However, there are several weak areas in the procedures that detract from the reliability of the results. Weaknesses inherent in a timber inventory are carried over into the yield analysis process. The time taken to complete the determination of allowable annual cuts (AAC's) for Timber Supply Areas is too long.

A key to reliable yield analysis, as conducted by the MOF for Timber Supply Areas and some Tree Farm Licence holders, is the determination of long-run sustained yield of the net productive land base in the management unit. Long-run sustained yield analysis is totally dependent on knowledge of the productive capacity of the land base and sound growth and yield information. This information is often critically lacking. The review concludes that currently used yield forecasts tend to be conservative and thus the long-run sustainable yield forecast may also be conservative.

Several improvements that should be made to the yield analysis process have been suggested to provide more accurate, reliable and complete results.

Given the uncertainties in the timber inventory database, the lack of growth and yield data and the inconsistencies in determining net productive land base, it is concluded that there can only be limited confidence in the current yield analysis results.

Thirty-two recommendations for improving forest resource inventories and providing more reliable yield analyses are contained within the report. The prime recommendations are summarized as follows:

1. Forest Resource Inventory Task Force

An immediate priority should be the establishment of a provincial Forest Resource Inventory Task Force, comprised of:

- The government ministries involved, particularly Forests, Crown Lands, Environment and Parks;
- Representatives of the industrial forest resource users;
- Representatives of the non-industrial forest resource users.

The Task Force's mandate would be to design and plan compatible forest resource inventories to standards required to meet today's and future resource management needs. The Task Force would also be asked to specify guidelines for establishing inventory priorities throughout the Province.

2. Re-Inventory Program

A subcommittee of the provincial Forest Resource Inventory Task Force should undertake an immediate and critical review of the MOF Re-inventory Program in relationship to current and future needs of more specific timber inventory information. A new inventory sampling design and program for the timber resource must be developed to meet today's and future requirements.

3. Growth and Yield

A program designed to establish sample plots to fill the gaps in the existing data base must be started immediately, particularly in the younger age classes. A permanent sample plot program designed to provide reliable growth and yield functions must be instituted in both natural and managed stands.

4. Quality Control

A data management quality control program for timber inventory statistics should be established within the MOF immediately. The MOF establish "official" release-dated versions of their major data files.

5. Yield Analysis Process

A subcommittee of the provincial Forest Resource Inventory Task Force should review the analysis process in view of the need to improve the information used and to adopt more efficient and effective procedures. Sensitivity analyses of the assumptions used in the yield analysis process and AAC determination must be done as an integral part of the process. The MOF should immediately begin the process of acquiring and calibrating successful, regional natural and managed stand growth models for use in planning, forecasting and analysis for all major commercial species in the Province.

6. AAC Determination

Significant changes from current levels of AAC should not be made until there is a more accurate inventory data base and an improved yield analysis process which clearly demonstrate that adjustments are justified.

The Consortium realizes that the findings with respect to AAC level are contrary to the general public perception that the forests are being overcut. There is some room for optimism concerning future wood supplies, assuming no large forest land alienations occur that reduce productivity. It will also require implementing action to substantially improve the current forest resource information data base and development of strategic fibre-flow goals for each management unit, and the Province.

The Consortium wishes to point out that the recommendations presented are to augment current initiatives within the MOF. New programs, systems and approaches are being adopted by the MOF in an attempt to improve present timber inventories and yield analysis procedures.

A major commitment to forest resource inventory funding by government will have to be established to accomplish the recommended tasks. The importance of providing for reliable inventory data can not be overstressed. The most important principle must be that the funding mechanisms be established to ensure continuity of the programs.

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APPENDICES

Appendix A Terms of Reference for Consulting Firms

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ACKNOWLEDGEMENTS

Throughout the individual management unit reviews and this summary, Ministry of Forests and Ministry of Environment staff have been most helpful. We wish to recognize their co-operative, prompt and courteous help in supplying requested information and in providing assistance in interpretation and background.

We also would like to recognize the same level of co-operation and assistance from the staff of the Tree Farm Licence holders involved in this review.

FOREST MANAGEMENT UNITS STUDIED

1.0 INTRODUCTION

1.1 PURPOSE

During the past year, the B.C. Forest Resources Commission (FRC) has invited submissions from individuals and organizations on the management of B.C.'s forests. The FRC has also received input by conducting province-wide public meetings. During the processes, the members of the FRC heard frequent references from the public that the forests of British Columbia are being overcut, and that the timber inventory was unreliable. These statements, together with allegations that the forests of the Province were being mismanaged, prompted the FRC to undertake a technical review to determine the accuracy of timber inventories and the procedures by which the allowable annual cuts (AAC's) are determined.

The need for this technical review can be seen, in part, as a response to the rapid change in the public values and regard for the provincial forest resources. The Ministry of Forests (MOF) has been entrusted to manage the public forests. Until recently, this management has occurred with minimal public scrutiny. The public is now often confused and is questioning the forest management policies of the government. The activities of the forest industry in the public forests are no longer being accepted without the opportunity for public review and input.

A ground swell of public opinion is questioning the forest inventory information on which resource management decisions are based. There is a demand that better data be made available. The public has a perception that the provincial forests are being overcut. This concern is exacerbated by recent mill closures and associated loss of employment. All the concerns are heightened by the quite evident and often extensive clear cuts throughout the Province.

The objectives of this technical review of forest inventories, yield analysis and AAC determination were to:

- **Assess the Accuracy and Appropriateness of the Inventory Data:**
  - Assess the objectives of the inventory and the appropriateness of the inventory design to meet those objectives;

- Assess the accuracy and technical strength of techniques used for assigning type labels to maps, and for assigning and projecting volumes to standing inventory;
- Assess the effects of inventory problems on AAC determinations, and

- **Assess the validity of the yield analysis procedures and the appropriateness of AAC determinations:**
  - Assess the relevance of yield analysis procedures to AAC objectives;
  - Assess the practicality, effectiveness and technical strengths or weaknesses of the yield analysis procedures.

1.2 STUDY ORGANIZATION

The FRC wanted technical critiques of the timber inventories and AAC's from a selection of management units broadly covering the Province. Accordingly, the decision was made to have at least one study in each Forest Region and include both Timber Supply Areas (TSA's) and Tree Farm Licences (TFL's).

The FRC engaged a Project Co-ordinator, known as the HST Consortium (HST), to advise the FRC on the Terms of Reference, co-ordinate the technical reviews by seven consulting firms and present a consensus report to the FRC of the key findings of the project.

The units selected for study were as follows:

Cariboo Forest Region	- Quesnel TSA
Kamloops Forest Region	- TFL #35
Nelson Forest Region	- Golden TSA
Prince George Forest Region	- Fort St. John TSA
Prince Rupert Forest Region	- TFL #51
Vancouver Forest Region	- Sunshine Coast TSA
Vancouver Forest Region	- TFL #6

The seven consulting firms were assigned to study the following management units:

CONSULTING FIRM	MANAGEMENT UNIT	AAC (Mm^3)	NET PRODUCTIVE AREA (ha)	LAST INVENTORY DATE
Forgis Resource Consultants Ltd.	Golden TSA	650	174 400	1968
Fortrends Consulting Inc.	Sunshine Coast TSA	1 445	244 962	1962-70
Hugh Hamilton Limited	Quesnel TSA	2 935	1 161 300	1963-75
Industrial Forestry Service Ltd.	Fort St. John TSA	1 815	1 043 200	1964-71
Sterling Wood Group Inc.	TFL #35	88	36 869	1978
Stewart & Ewing Associates Ltd.	TFL #6	1 300	143 819	1979
Sylvametrics Consulting	TFL #51	110	40 793	1973

The reports for each management unit from the consulting firms were submitted to the FRC, and in turn released to HST for review and summary. Other inventory and yield analysis specialists were engaged by HST to comment on this complex technical subject and to critique this report. This report summarizes the collective assessment, conclusions and recommendations from a broad spectrum of forestry consulting firms.

2.0 HISTORICAL OVERVIEW

The techniques for preparing timber inventories and for setting AAC's of forest units in B.C. have been developed and refined continuously during the last 25 years. The availability of computer-assisted technology in the 1980's has meant that forest managers can provide and maintain inventory estimates and, analyze AAC levels with a higher degree of reliability than was possible before. The level of accuracy nevertheless is dependent upon the sampling design of the inventory and the quality of the information it provides. Most of the B.C. timber inventory data base is now 15-20 years old. The reliability of this inventory is under serious question.

Although there are various techniques to conduct a timber inventory, they all involve the use of aerial photographs, photo interpretation and the employment of a sampling system to provide estimates of volume and yield. The information is then processed and analyzed to produce an inventory data base and accompanying forest cover maps.

In British Columbia, the MOF has developed and maintained the forest inventory data base for public forest land, with the exception of TFL land base. TFL inventories have been the responsibility of the TFL holders.

2.1 TIMBER INVENTORIES

2.1.1 MOF Inventory Program

Prior to 1961, the MOF had carried out low intensity and maintenance surveys throughout the Province. In 1961 a totally new inventory system, the Continuous Forest Inventory (Unit Survey), was introduced. The system was designed to provide reliable forest inventory statistics for large forest management units termed Public Sustained Yield Units (PSYU's), primarily for use in the determination of AAC's. The design of the system did not intend for volume estimates to be reliable at the individual stand level. The expectation was that this system would provide a continuous re-inventory of the Province every ten years.

MOF inventory crews were well trained, and carried out their field work under close supervision and quality control. They had a team approach ensuring that all inventory tasks

from forest type delineation, location of sample plots, ground and air checks, mapping and data compilation were carried out by skilled crews trained to work together and accurately. The Unit Surveys were conducted between 1961 and 1977, at which time inventory coverage of the Province was essentially complete.

During the period 1953-1962, the MOF carried out a program of volume and decay sampling. This work was to provide volume tables and net volume loss factors to apply to gross volumes for all the commercial species. The sampling was done for broad geographic areas of the Province supporting similar forest types. The areas were defined as Forest Inventory Zones (FIZ's). These FIZ's, with limited boundary changes, are still used today in choosing volume curves and loss factors to apply to gross volumes in the process of preparing volume estimates for a specific management unit.

The B.C. inventory system as designed in 1961 was considered reliable, sophisticated and well ahead of other provinces in Canada.

The Unit Surveys for PSYU's were essentially completed in 1977, however, the cyclic re-inventory was not started as the MOF had intended. Instead, some refinements and updating of the data base and some sub-unit surveys were carried out. Notable refinements were the classification of environmentally sensitive areas (ESA's) and the conversion of the data base from imperial to metric units.

One of the weaknesses of the Unit Survey sampling design, which is a serious problem today, was the emphasis placed on sampling only the merchantable conifer volume of the forest. Low priority was given to sampling young (immature) stands and deciduous stands. The smaller diameter lodgepole pine stands were considered non-merchantable and were only sampled at a low intensity. During the last 25 years many of these stands have become acceptable commercial species. There is a major gap in the inventory data base for the younger stands and the species mentioned, as a result, there is a general lack of confidence in the inventory for many units.

From about 1976 until 1988, no major inventories were conducted. It should be noted that the provincial forest inventory is still based primarily on the Unit Survey data and volume and decay sampling of the previous two decades. As a result, AAC's are based on this data.

During this same period, a major reorganization and decentralization of the MOF occurred. New forest management units termed TSA's were established by amalgamating PSYU's. The field inventory responsibility for the TSA's was decentralized from Victoria to Regional offices. There was a lack of emphasis on field data collection, albeit that budgets were limited. This attitude has prevailed to date.

This was also a period of rapid expansion of the forest industry, especially in the interior of B.C. Virtually all of the available AAC was allocated to supply regional industry's timber needs. The Unit Survey inventory statistics were used as the basis for TSA planning and development. By the mid 1980's, with the increasing competition for log supply, it became apparent that the forest inventory was outdated. Forest planners were expecting more detail from the data base than it was originally designed for and thus able to provide.

During the 1980's, government funding for inventory programs was greatly reduced, and those for reforestation programs tripled. Despite the pressures from the MOF, professional foresters and the forest industry to upgrade and improve the provincial inventory, these proposals did not receive government approval.

In 1988, the MOF request to implement a 10 Year Provincial Re-inventory Program was approved. The introduction of a cyclic re-inventory has been well received, however, there are serious flaws in the design and approach of this Re-inventory Program. In addition, the first three years of this program have been funded considerably below the planned budget. This lower budget has resulted in a consequent reduction in some essential inventory phases such as field verification and volume sampling.

2.1.2 TFL Inventories

The timber inventory of a TFL has always been the responsibility of the TFL holder. When the TFL's were first awarded in the 1950's, the existing provincial inventory for that unit was used as the basis for setting the first five year AAC.

During the mid to late 1960's most TFL holders initiated their own new inventories, generally to the same standards that the MOF was following for its Unit Surveys. Data for loss factors and volume estimates was taken directly from FIZ data, or developed specifically for the TFL using MOF methodology. Therefore, most TFL inventories evolved from

similar data bases and were conducted during the same time period as the MOF Unit Surveys.

The TFL holder has the discretion to conduct timber inventory with objectives and techniques that vary from MOF procedures. The results have been that TFL inventory standards have met or exceeded the standards of the MOF. Many TFL holders have been quite innovative in conducting their inventories.

Until 1987, the cost of TFL inventories was either fully or substantially borne by the MOF. Since 1987, government funding assistance has been limited to the acquisition of aerial photographs and digital map production.

Most TFL holders have continued to maintain, update and refine their TFL inventories since the original completion. At the same time, despite the funding assistance, the inventory data base of TFL's was not required to be provided to the MOF.

2.2 YIELD ANALYSIS

One of the applications of the provincial timber inventory is for assessing the feasible level of annual harvest for each management unit. The annual harvest level is termed the AAC. Under the Forest Act, only the Chief Forester is authorized to approve the AAC for a TSA or TFL. The yield analysis provides detailed information on the short-term wood supply and the potential long-term harvest level.

Prior to 1980, the MOF used a yield regulation formula known as the "modified Hanzlik formula." This procedure checked that the harvest level selected was sustainable over a period of at least one rotation. It was a simplistic approach, based on the inventory statistics at the time. This system did not adequately account for the dynamics of forest growth. The determination of the AAC for each TSA and TFL has now become a complex, technical process.

After 1980, the MOF introduced major changes in harvest regulation policy. Adoption of the use of computer-generated forest estate modelling enabled the MOF to analyze what would be the "optimum" harvest schedule over a 200+ year planning horizon. Forest estate modelling is a planning tool that allows for the examination of management assumptions and their impact on projected wood supplies. These assumptions include net productive forest

area, harvesting age, accessibility, alternative harvest rates, alternative silvicultural regimes, forest protection, wildlife and other environmental considerations. For a particular management unit, by varying the forest management assumptions, different long-term harvest levels can be identified.

By 1984, yield analysis using forest estate modelling had been completed for all TSA's in the Province. This approach, using the assumptions and procedures adopted by the MOF, indicated that with the transition from old growth to second growth harvesting, the AAC level would have to be reduced in many TSA's. In some management units this reduction would be required immediately, in others, not for many decades.

One of the criticisms of this new approach is that the forest inventory data base and yield curves available are not sufficiently detailed or refined to produce reliable results. For any given yield analysis, the projected harvest level is only as good as the management assumptions taken and the precision of the inventory statistics. The confidence limits in the harvest levels produced are sometimes low. The results of the yield analyses often need subjective interpretation. In recognition of the limitations, the MOF has tended to take a conservative approach when assessing harvest levels. Conservatism is equally hazardous to optimism in yield analysis and may lead to unnecessary AAC reductions, economic disruptions and intensify resource management conflicts.

More recently, the MOF and TFL holders have been examining forest estate models that are better able to simulate the operational reality and sensitivity of forest management assumptions. By using a simulation-based forest estate model, the sensitivity of the harvest level in choosing a set of management assumptions is more easily analyzed and the feasible management options identified.

The procedures by which the results of a yield analysis lead to the chosen AAC by the Chief Forester are outlined in the next section.

2.3 AAC DETERMINATION

The MOF has established a detailed planning process that culminates in the determination of the AAC by the Chief Forester. It is important to understand that the AAC is not derived by a single calculation but is the result of a series of planning steps.

For each TSA, the process is guided by a TSA Steering Committee, comprised of representatives from the MOF, the forest industry and other resource interest groups. After the Committee has agreed on the terms of reference for the process, the yield analysis is carried out by the MOF.

A **Timber Supply Analysis Report** is written, outlining the yield analysis results and describing the management assumptions used. This, in turn, leads to the **TSA Options Report**, which details the potential AAC levels, the management options and the consequences accompanying each option.

After review by the TSA Steering Committee, a recommended AAC is submitted to the Chief Forester for his consideration. The Chief Forester makes the AAC determination after further assessing the social and economic ramifications of the recommended AAC level. The basis for this decision is usually documented as the **AAC Rationale**, a written statement which outlines the key management assumptions to be followed by the TSA Plan for the next five years.

A similar process is followed for determining the AAC of TFL's. The exception is that the planning activities are the responsibility of the TFL holder within a process defined by the MOF. TFL holders are required to re-assess their AAC determination every five years and the timing is strictly monitored by the MOF. There is no regulated time requirement for TSA's, although MOF policy requires that the AAC for TSA's are to be re-assessed every five years.

The yield analysis process for both TFL's and TSA's provides for public review and input.

Due to the large volume of old growth timber in most management units of the Province, the AAC generally has been set above the long-term sustainable level. This has been a deliberate decision with the understanding that the AAC will be reduced over a period of several decades to a sustainable level. The link between the AAC rationale and forest management activities implied in the yield analysis is the **TSA Plan**. It is through the TSA Plan that forest management strategies should be outlined that may alleviate or nullify decline in the harvest level.

3.0 OVERALL ASSESSMENT AND SUMMARY OF RECOMMENDATIONS

In this section the main findings of the technical reviews are summarized. An interpretation and assessment of the collective documentations from the consulting firms' reviews on the status of the forest inventory and the AAC planning process is made.

The seven independent reviews examined seven management units within the Province. These units represent a wide variation of timber types, terrain, accessibility, area and have their own unique inventory requirements. Nevertheless, there is a remarkable consistency in the findings of the seven reviews, both in the observations and the recommendations.

3.1 ACCURACY AND APPROPRIATENESS OF THE INVENTORY DATA

The MOF Inventory Branch has the mandate to maintain a provincial forest inventory. There is little doubt that they have endeavoured to carry out their responsibilities given the realities of funding restraints. Indeed, credit must go the MOF for their efforts during the last 10 years to keep up with new technology and to introduce the latest inventory procedures.

Since 1978, the MOF forest inventory program has focused on technical development. This includes fast access to the data base, digital map production and remote sensing. The MOF has been progressive in introducing geographic information systems into an operational environment. These efforts have led to both national and international recognition.

During this period, the inventory data base was updated for depletion rather than an overall upgrading in the level of accuracy. We can conclude that the provincial inventory data base in place in 1990 is essentially based on a sampling design and procedures from the 1960's. This timber inventory provided acceptable statistics and gave a sound basis for forest planning and the setting of AAC's throughout the Province for the subsequent 20 years.

The reviews of the TSA's revealed that there is still a basic reliance on old inventory data. These inventories were deemed to be adequate for the level of use for which they were

originally designed, which was to provide statistics for broad unit level planning. The TFL inventories are more recent and provide reliable data at a more detailed level.

A key question asked is "are the inventory volumes accurate?" The answer is **Yes** if it is meant to apply to large management units containing mostly older age class timber where individual stand data has been aggregated. The answer is **No** if it is meant to provide accurate volumes for smaller areas, i.e. watersheds or specific forest stands or management units with mostly younger age class timber.

The inventory statistics currently available are not sufficiently accurate to answer the kinds of management information needed today, let alone the future. The current demands from this inventory information now exceed the confidence limits of the original design. Both the MOF and other users have been applying the inventory statistics beyond their limits of reliability. This includes allocating new cutting rights to a specific set of timber types, or compiling timber volumes at a polygon level for specific short-term planning.

There is no doubt that the forest industry in the Province is on the edge of a new era both in terms of the environment, social values, new product development and marketing. In coastal B.C. the transition from the harvesting of old growth to second growth has begun. The timber inventory of these second growth forests is poor and the data base for the growth rates is extremely weak. There is very little recognition of stand dynamics, especially in mixed species stands and following crown closure in young stands.

The other key question is whether "the inventory procedures are appropriate?" The answer is **Yes** they were for the purpose for which they were designed, but they are **Not** adequate to provide the level of inventory information needed now. The inventory procedures have not been adjusted rapidly enough to keep pace with the information demands of forest managers and the public.

In essence, this review concludes that the current timber inventory has become outdated and is weak in several specific technical elements. The inventory should be upgraded to a more detailed level. Specifically:

1. The estimates of merchantable volumes and the predictions of yield from young stands must be improved.

2. There needs to be a significant increase in field sampling to improve the accuracy of stand labels and volume estimates.

3. A much greater emphasis must be placed on growth and yield data collection.

Implementation of these three elements will greatly improve the confidence in the quantification of inventory volume estimates for reliable yield analysis.

Concurrent with new timber inventories must be new policies and procedures to ensure the inventory of associated forest resources. Inventories of trees are relatively static, whereas inventories of other resources are often dynamic, not as easily quantified and do not always justify expensive detailed inventory work.

User access to the inventory statistics is now a relatively simple procedure with the advent of computer technology. This convenient availability has resulted in a surge of user demand for a variety of applications. The MOF needs to become client-orientated in supplying inventory statistics and ensuring that only quality controlled data is released.

The Provincial Re-inventory Program that began in 1988 does not appear to be addressing all of the technical weaknesses of the current inventory. The main goal appears to be the production of reclassified digital forest cover maps. There is very little emphasis on field verification of the timber stands. The general consensus of the consulting firms involved in this review is that the current approach will not make a significant improvement to the accuracy of the inventory data base. For these reasons, there was unanimous consensus that the Re-inventory Program must be re-assessed immediately and that it be given a new direction.

Listed below are the recommendations concerning forest inventory that have been developed from the review. The order of the recommendations follow the development of the topics in Section 4 of the report.

Inventory Recommendations

1. An immediate priority should be the establishment of a provincial Forest Resource Inventory Task Force, comprised of:

   - The government ministries involved, particularly Forests, Crown Lands, Environment and Parks;
   - Representatives of the industrial forest resource users;
   - Representatives of the non-industrial forest resource users.

   The Task Force's mandate would be to design and plan compatible forest resource inventories - timber and other forest resources - to standards required to meet today and future resource management needs. The Task Force would also be asked to specify guidelines for establishing inventory priorities throughout the Province.

   Subcommittees should be established for each individual forest resource inventory such as timber, recreation, wildlife, soils and water. These subcommittees would deal with the technical aspects of the inventory directly related to their area of interest.

   Co-ordination of the subcommittees would be the responsibility of the Task Force, ensuring compatibility and budget priority.

2. A subcommittee of the provincial Forest Resource Inventory Task Force should undertake an immediate and critical review of the MOF Re-inventory Program in relationship to current and future needs of more specific timber inventory information.

3. A standard provincial base map and scale for all forest inventories must be introduced. The TRIM map base system is currently being used by other government ministries and some companies and should be integrated with the MOF Re-inventory Program. Adoption of this system as the provincial standard should be reviewed as a first priority.

4. A new inventory sampling design and program for the timber resource must be developed to meet today's and future requirements. Increased emphasis must be placed on collecting polygon-specific data.

5. Re-inventory projects should focus on priority areas rather than be "blanket" re-inventory of the management unit.

6. Consistent, compatible and reliable inventories of ALL forest resources must start immediately to avoid, or at least ease, the continuum of forest resource conflicts,

7. A program designed to expand the sample plot program to fill the gaps in the existing data base must be started immediately, particularly in the younger age classes.

8. A permanent sample plot program designed to provide reliable growth and yield functions must be instituted in both natural and managed stands.

9. Procedures for incorporating the operational cruise data with provincial inventory data bases should be developed and implemented. It should be linked with a program of monitoring inventory volume predictions with operational cruise volume estimates and harvest depletion volumes.

10. Strong support should be given to the current MOF initiatives to improve the provincial loss factor system. It requires establishing priority sampling areas and the compilation of the new data.

11. The design of the timber inventory system must provide for more ground sampling to reliably estimate the site productivity.

12. Strong support should be given to the MOF initiatives to improve the mixed deciduous/coniferous inventories in the NE portion of the Province.

13. Coniferous area inclusion factors should be applied to deciduous types until experience in utilization of these types is developed and can be used in defining the net land base of this timber component.

14. If the apportionment and commitments to harvest remain separated for coniferous and deciduous forests, then the yield analysis should also be evaluated separately.

15. The establishment, planning and management of environmentally sensitive areas should be based on the total forest resource inventory data base and the management strategies

for the management unit. This needs to be reviewed and incorporated into re-inventory plans of the MOF.

16. A quality assurance/quality control group and program for data management should be established within the MOF immediately.

17. The MOF must establish "official" release-dated versions of their major data files. These files would be the official data sources for planning and analysis work until the next issued "official" file.

3.2 VALIDITY OF YIELD ANALYSIS PROCEDURES

The current timber supply planning process used by the MOF attempts to balance the needs of all forest resources. The resultant AAC is a subjective determination made by the Chief Forester after considering all the technical, social and economic options available. It is based on the results of a yield analysis that links the current merchantable volume with anticipated timber yields in the future.

The question is whether or not the yield analysis procedures followed by the MOF are technically valid and provide reliable estimates of feasible long-term harvest levels.

The consulting firms' reviews reported that the MOF had carefully and meticulously followed the required yield analysis procedures. However, the studies commented that there are several weak areas in the procedures that detract from the reliability of the results. It is evident that any inherent weaknesses in the timber inventory are carried over into the yield analysis.

One of the key determinants of the long-run sustainable yield (LRSY) is the net productive forest land base and the yield predicted from this land base. The net productive land base is often determined in a subjective manner and is inadequately documented. It is difficult to assess the reliability in these procedures, except to comment that a conservative approach has been taken.

The predicted yield beyond the period when it is assumed the old growth volume will have been harvested is very dependent on the validity of the growth model used and the data

relating to the productivity of the land base. The consulting firms' studies unanimously found that growth and yield information for the major species/type groups is poor. The collective opinion was that yield forecasts tend to be conservative. The conclusion is that the long-term harvest forecast from the yield analysis may also be conservative. Given the uncertainties in the inventory data base and the derivation of the net productive land base, it is difficult to definitely conclude that present AAC's are conservative.

Forest estate modelling is used to predict harvest levels. The results are only as reliable as the management assumptions used. The MOF needs to be more flexible in using the model, given that it is only a planning tool to guide AAC decision making. Given that these forecasts are used to develop a recommended AAC level, greater use of sensitivity analysis should be made to assess the impact on the indicated harvest levels to changes in key technical and management assumptions. If the MOF was open to using other yield functions and forest estate models currently available, the confidence in recommended harvest levels would increase.

The planning process for TSA's, which involves consultation by committee and the involvement of MOF Regional and Branch staff, takes too long to complete. Although the process is technically complex, the procedures must be streamlined so that the management assumptions do not lose their validity before the AAC is determined.

The planning process is presently designed to allow for a multitude of resource considerations, values and problems. The success of the analytical process in dealing with these resource issues is questionable. It was concluded that there is need for standardization of the process and for better documentation of the assumptions. More operational monitoring is required to ensure the planning decisions are technically sound.

The responsibility for the planning process could be re-assigned to MOF District staff who have a better appreciation of the local planning issues and the forest management options. This change, if implemented, would more closely parallel TFL management.

3.3 APPROPRIATENESS OF AAC DETERMINATION

The studies found that the MOF procedures had been followed in determining the AAC for the management units reviewed. No evidence of political influence on the determination made by the Chief Forester was found. Given that the AAC determination is a management decision and not a technical calculation, the question is whether the AAC level chosen is reliable. Our answer must be that it is questionable, given the unreliability of the inventory data base and the uncertainties inherent in the yield analysis procedures. Steps need to be taken to improve the technical data and therefore the confidence in the basis for the AAC.

Information supplied by the MOF for all TSA's in the Province reveals AAC's on average are 30% higher than the LRSY's. It can be misleading to assess the AAC at a provincial level. The AAC for each management unit is determined independently, and depends on the individual circumstances. In the case of management units with a disproportionately large volume of overmature timber, it can be acceptable for the AAC to be at a higher level than the LRSY. In fact, there have been temporary AAC increases to allow increased harvesting of timber damaged from bark beetle attacks or other natural catastrophes. They are both appropriate and responsible short-term measures, and cannot be viewed as overcutting.

Nevertheless, the provincial AAC must eventually be managed in relative balance with the productive capacity of the forest land. This must be either through reductions in AAC, or by increasing the LRSY, or a combination of both. It requires the setting of long-term harvest goals for each management unit and the implementation of management strategies to achieve them.

The recommendations concerning yield analysis procedures and AAC determination are listed below.

18. The MOF must develop a process that can objectively define the term "productive forest land" for each TSA and TFL.

19. Consistent procedures must be developed to derive the net down of the productive land base. If there is variance to the procedure, it must be documented. Release-dated files should be used during the yield analysis process.

20. In future yield analyses, NSR areas should be included in the net productive area with appropriate regeneration delays and yield tables.

21. Document the reconciliation of Inventory and Silviculture Branch records in the yield analysis process. The dual record keeping of NSR statistics by MOF Inventory and Silviculture Branches should be structured in a compatible format.

22. It is essential that a process for determining area inclusion factors based on objective criteria be developed.

23. Definition of problem forest types should be based on historical harvest profile and current definitions of merchantability. Monitoring of these areas should be continuous and the yield analysis process flexible and responsive to timely change if required.

24. The yield analysis process should include a complete examination of the sensitivity to LRSY from different inclusion factor options, including consideration of future timber utilization potential.

25. The MOF should immediately look at the use of yield analysis software that does not require the current aggregation limits.

26. The aggregation process must consider what is biometrically and statistically correct within species and between species.

27. The MOF must immediately begin the process of acquiring and calibrating external, successful, regional natural and managed stand growth models. These models should then be used in planning, forecasting and analysis for all major commercial species in the Province.

28. Sensitivity analyses of the assumptions used in the forest estate model must be done as an integral part of the yield analysis and AAC determination process.

29. A monitoring program that will allow investigation into the operational validity of the assumptions used in the model must be implemented as one aspect of an overall quality assurance/quality control program.

30. A subcommittee of the Forest Resource Inventory Task Force should review the analysis process in view of the need to improve the information used and to adopt more efficient and effective procedures. The review must include reducing the time it takes to complete a TSA Plan. The task should be completed and the recommendations implemented within 12 months.

31. The MOF adopt the use of stand and forest level simulation models to do yield and sensitivity analysis at the Region and District level. Once this initial work has been done at the Regional and District level, Integrated Resources Branch would review the analysis for completeness, consistency and compatibility.

32. Significant changes from current levels of AAC should not be made until there is a more accurate inventory data base and an improved yield analysis process which clearly demonstrate that adjustments are justified. Any changes should be made within the context of a strategic fibre-flow plan for the management unit.

Overall, a significant number of recommendations have been developed in this review. These recommendations are intended to augment a number of initiatives currently being pursued by the MOF and some TFL holders. Many of these initiatives have been, and continue to be, delayed and frustrated by a lack of budget commitment.

A major commitment to funding by government will have to be established to accomplish these recommended tasks. This budget and the resultant improvements will provide a more reliable information base to plan and execute sound, environmentally sensitive, sustainable forest resource management.

4.0 ISSUES, OBSERVATIONS AND RECOMMENDATIONS

In this section we present the evaluation issues, observations and recommendations. These have been organized into three main headings:

- Inventory;
- Yield Analysis;
- Assessment of Allowable Annual Cut.

These three categories represent the major areas reviewed in the seven independent technical reports and our summary. A number of issues are presented in each category, observations are summarized from the individual technical reports and, as appropriate, recommendations are provided for improving future inventory and yield analysis work done in the Province.

4.1 INVENTORY

4.1.1 Forest Cover Mapping

The basic elements of forest resource inventories are:

- The base map;
- The stratification of forest resource types into polygons;
- Polygon classification.

It is essential for forest management analysis and planning that all three of these factors are carefully designed, executed and recorded to meet the objectives of the resource owners.

A. Issue

How well are these three basic elements handled in our current provincial timber inventories?

EXHIBIT 1. TOTAL AREA BY TYPE ID AND D CLASS
RANK 1 STANDS OWNERSHIP 62 ONLY

SUNSHINE COAST TSA

DATA CLASS*

Type ID		Photo Int 0	Air Calls 1	70 mm Photo 2+3	Gnd. Calls 4	Samples 5+6	Ragen Surv. 7	Gnd. Obs. 8	Reserch Plots 9	Val Plots 10	Silv Treat 11	Dist. 12	Other 13+15+41+51	TOTAL
Immature	1	92 835.5	41 501.4	8 471.5	19 128.8	17 604.5	41 831.7	3 205.3	21.2	0.0	11 432.6	70.2	1 566.5	237 699.2
Mature	2	93 737.5	62 261.6	2 151.2	11 209.1	14 267.3	142.0	438.3	0.0	26.3	80.3	0.0	444.9	184 758.5
Resid.	3	144.6	0.0	0.0	10.0	0.0	0.0	52.1	0.0	0.0	0.0	0.0	0.0	206.7
NSR	4	2 115.3	30.2	72.1	197.5	423.9	2 455.9	10.1	0.0	0.0	189.6	2 364.4	0.0	7 859.0
Non-Comm.	5	56.1	0.0	0.0	0.0	0.0	0.0	42.5	0.0	0.0	0.0	0.0	0.0	98.6
Non-Prod.	6	576 587.8	8 686.3	21.5	317.2	41.1	646.9	493.4	0.0	0.0	29.6	1 553.2	0.0	588 377.0
DSD	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Not Typed	8	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
Silvi Layer with NSR	9	0.0	0.0	0.0	0.0	0.0	49.3	0.0	0.0	0.0	5.1	0.0	0.0	54.4
Total		**765 481.8**	**112 479.5**	**10 716.3**	**30 862.6**	**32 336.8**	**45 155.8**	**4 241.7**	**21.2**	**26.3**	**11 737.2**	**3 987.8**	**2 011.4**	**1 019 058.4**
%		**75.1**	**11.0**	**1.0**	**3.0**	**3.2**	**4.4**	**0.4**	**<0.1**	**<0.1**	**1.2**	**0.4**	**0.2**	**100.0**

GOLDEN TSA

Total		**714 228**	**93 916**	**414**	**27 632**	**30 435**	**15 975**	**486**	**0**	**0**	**11 572**	**24 693**	**0**	**919,551.0**
%		**77.7**	**10.2**	**<0.1**	**3.0**	**3.3**	**1.7**	**<0.1**	**0.0**	**0.0**	**1.3**	**2.7**	**0.0**	**100.0**

B. Observations

Base Mapping

There is concern that there is not a consistently accurate and compatible base map system being used in forest resource inventory work in the Province. Different map scales with different bases are being used for mapping forest inventory resources and other resources in the Province. This will lead to incompatible data and severely inhibit the application of watershed and polygon level planning tools such as GIS. More use should be made of the provincial TRIM base system when new inventories are carried out.

Stratification

Concerns were raised in all of the TSA's reviewed that the stratification standards for the old Unit Surveys are inadequate to meet the demands of today's planners, users and owners. The level of refinement in stratification varies widely by TSA. The current re-inventory program does not address the need to redefine type boundaries to new attribute standards. The amount of field verification being done in these inventories is very limited and is considered inadequate.

Timberline Forest Inventory Consultants suggest that "during the last three years the level of polygon visitations ranges from 1-3%" in the TSA re-inventories. This is borne out in **Exhibit 1** (opposite) that indicates by percentage, the techniques used to collect the data used to identify timber polygon labels reflected in the current inventory data bases for these two TSA's. The same concerns were not expressed by the studies done of the TFL's.

It was noted that some stratification was done using photos considered "out-dated" by the consultants.

Polygon Classification

Classification of polygons appears to be a critical deficiency. Despite progressive inventory standards that relate the assignment of inventory attributes to timber polygons, as seen in **Exhibit 1**, the process is heavily dependant on photo interpretation. Considering the major

attributes of species composition, age, height, diameter and stocking, it is entirely conceivable that on a polygon by polygon basis over 75% of the stands in the Golden and Sunshine Coast TSA's may not meet classification standards.

Industrial Forestry Service Ltd. reported that in the Fort St. John TSA for 100 ground samples checked, 65% had the incorrect type group, 60% had the wrong age class and 50% had the wrong site class. It appears that the current MOF timber Re-inventory Program may not result in significant improvement over current inventories.

Because GIS is a polygon-specific tool, these shortcomings reduce the usefulness and effectiveness of this inventory in a meaningful way for a GIS application.

C. Recommendations

1. An immediate priority should be the establishment of a provincial Forest Resource Inventory Task Force, comprised of:

- *The government ministries involved, particularly Forests, Crown Lands, Environment and Parks;*
- *Representatives of the industrial forest resource users;*
- *Representatives of the non-industrial forest resource users.*

The Task Force's mandate would be to design and plan compatible forest resource inventories - timber and other forest resources - to standards required to meet today and future resource management needs. The Task Force would also be asked to specify guidelines for establishing inventory priorities throughout the Province.

Subcommittees should be established for each individual forest resource inventory such as timber, recreation, wildlife, soils and water. These subcommittees would deal with the technical aspects of the inventory directly related to their area of interest.

Co-ordination of the subcommittees would be the responsibility of the Task Force, ensuring compatibility and budget priority.

2. ***A subcommittee of the provincial Forest Resource Inventory Task Force should undertake an immediate and critical review of the MOF Re-inventory Program in relationship to current and future needs of more specific timber inventory information.***

3. ***A standard provincial base map and scale for all forest inventories must be introduced. The TRIM map base system is currently being used by other government ministries and some companies and should be integrated with the MOF Re-inventory Program. Adoption of this system as the provincial standard should be reviewed as a first priority.***

4.1.2 Inventory Sampling Design

The sampling design of an inventory is dependent on the intended applications of the resultant data. Accurate sampling data will not be useful if the design of the inventory does not meet the needs of the users of this data in terms of completeness and applicability.

A. Issues

Does the design of the current timber inventory activities address known deficiencies in the existing inventory for the major inventory attributes?

Does the current inventory contain sufficiently accurate information to conduct reliable yield analyses?

B. Observations

It was generally concluded that the Unit Survey Information was adequate to meet the objectives of forest planning in the late 1960's and early 1970's when they were first carried out. However, it was also concluded that the standards needed for today can not be met by the current data base. Significant deficiencies were noted by all the consultants particularly in age class and species distribution of the sample data base.

EXHIBIT 2. NUMBER OF TEMPORARY SAMPLES, OPERABLE FOREST AREA IN FOREST TYPE, AND AREA PER TEMPORARY SAMPLE BY AGE CLASS AND LEADING SPECIES GROUP IN THE SUNSHINE COAST TSA

LEADING SPECIES GROUP LABEL	SPECIES COMPOSITION (MOF Codes)	VARIABLE	MOF AGE CLASS 0	1	2	3	4	5	6	7	8	9	Total
Fd	F, FPL, F Decid, FC and FH	# of Temp. Samples	0	0	0	13	23	28	16	4	84	46	194
		Area in forest type	993	8448	4975	9152	8442	16381	11958	7071	8933	23079	97432
		Hectares per Sample				704	367	585	747	1768	106	502	502
Pw	Pw	# of Temp. Samples	0	0	0	0	0	0	0	0	0	0	0
		Area in Forest Type	0	31	0	0	0	0	0	0	0	0	31
		Hectares per Sample											
Cx	C, CF, CH	# of Temp. Samples	0	0	0	0	9	17	4	6	58	86	180
		Area in Forest Type	1602	6275	1546	1829	382	441	622	809	861	1472	15859
		Hectares per Sample					42	26	156	135	15	22	99
Hx	H, HPl, H Decid, HF HC, HB and HS	# of Temp. Samples	0	0	1	7	14	35	13	5	62	133	270
		Area in Forest Type	5817	42088	6034	11286	6122	6246	5009	4604	3706	8740	99654
		Hectares per Sample			6034	1612	437	179	385	921	60	66	369
Bx	B, BH, BS	# of Temp. Samples	0	0	0	0	0	2	0	0	25	39	66
		Area in Forest Type	0	9656	3232	1703	254	256	304	536	397	2582	18920
		Hectares per Sample						128			15	66	287
Sx	S, SH, SC, S Decid	# of Temp. Samples	0	0	0	0	0	1	1	0	0	0	2
		Area in Forest Type	0	26	137	358	11	0	5	8	15	206	766
		Hectares per Sample							5				384
Pl	Pl, PlF, PlS, PlB	# of Temp. Samples	0	0	0	1	3	0	0	1	0	0	5
		Area in Forest Type	0	0	237	829	316	1393	821	906	73	58	4433
		Hectares per Sample				829	105			906			887
Dr	D Conif and D Decid	# of Temp. Samples	0	3	18	15	2	1	0	0	0	0	39
		Area in Forest Type	3160	5075	0	0	0	0	0	0	0	0	8235
		Hectares per Sample		1692									211
Mb	Mb	# of Temp. Samples	0	0	4	3	2	1	0	0	0	0	10
		Area in Forest Type	0	116	0	0	0	0	0	0	0	0	116
		Hectares per Sample											12
Cot, At Ac	Cot Conif. and Cot Decid.	# of Temp. Samples	0	0	1	1	0	0	0	0	1	0	3
		Area in Forest Type	0	0	0	0	0	0	0	0	0	0	0
		Hectares per Sample											
TOTAL		# of Temp. Samples	0	3	24	40	53	85	34	16	210	284	749
		Area in Forest Type	11572	71717	16161	24957	15527	24719	18719	13934	12005	36137	245448
		Hectares per Sample		23906	673	624	293	291	551	871	57	127	328
		Samples:											
		%	0	<0.1	3.2	5.3	7.0	11.3	4.5	2.1	28.0	37.9	100
		Cumulative %	0	0	3.3	8.6	15.6	26.9	31.4	33.5	61.5	99.5	100
		Operable Area:											
		%	4.7	29.2	6.6	10.2	6.3	10.0	7.6	5.6	4.9	14.7	100
		Cumulative %	4.7	33.9	40.5	50.7	57.0	67.0	74.6	80.2	85.1	99.8	100

NOTE: Temporary samples may be located in inoperable areas.
Area in forest type is reported for the operable forest landbase.

There is very little recognition of stand dynamics in the updating processes used by the MOF. This is particularly evident in mixed deciduous/coniferous stands and following crown closure in young stands.

Concerns were also raised about how applicable the old Unit Survey sampling was to today's harvesting activities. This was cited in terms of location, age class, site class, biogeoclimatic zone and species, particularly deciduous species in the NE portion of the Province.

Exhibit 2 (opposite) for the Sunshine Coast TSA illustrates the imbalance in inventory sample plots between species, age class and operable land base of each. The younger age classes contain a very low percentage of the samples. Slightly over half of the land base involved in the yield analysis contains less than 10% of the sample population. Accurate volume and growth information in these younger age classes is critically important to reliable yield analysis.

A related concern is the reliability of the samples established in the late 1960's and early 1970's to give accurate volume and yield estimates for areas that are currently being harvested. There is evidence that inventory plots are biased to areas with ease of access, often not representative of current harvesting areas.

Inventory sampling design must include other elements than volume such as:

- Classification of polygon attributes;
- Quantification of growth and yield;
- Loss factor analysis.

The current MOF timber Re-Inventory Program design is not addressing these needs adequately.

Polygon-specific data collection is critical to the successful implementation of GIS and related technologies in support of today's planning needs.

Forest resource inventories for resources other than timber are considered wholly inadequate for current forest planning needs.

C. Recommendations

4. ***A new inventory sampling design and program for the timber resource must be developed to meet today's and future requirements. Increased emphasis must be placed on collecting polygon-specific data.***

5. ***Re-inventory projects should focus on priority areas rather than be "blanket" re-inventory of the management unit.***

6. ***Consistent, compatible and reliable inventories of ALL forest resources must start immediately to avoid, or at least ease, the continuum of forest resource conflicts.***

4.1.3 Volume Estimates/Natural Stand Yield Curves

Timber inventory requires the development of volume estimates for "standing" crops and yield estimates for future crops. Sound timber management planning is directly dependent on reliable volume and yield estimates.

A. Issues

Does the current temporary sample data base allow for reliable volume estimates and yield curve functions?

Is the calculation of long-run sustainable yield (LRSY) biased by the current sample data base?

B. Observations

The current data base may be reliable for calculating standing volume in the older age classes but in many areas it does not appear adequate for determining standing volume or growth trends for the younger age classes. There is limited sampling in younger age classes. Yield analysis with a planning horizon of more than 30 or 40 years is totally dependant upon reliable "growth" and "volume" predictions of these younger stands.

Yield curve functions developed from the current data will be biased to longer rotation ages and lower culmination of mean annual increment (CMAI) as an artifact of the sample population in the older age classes. This has a significant effect on the resultant LRSY and harvest level calculations in the MOF yield analysis procedure. Often, the LRSY and harvest level will be lower as a result of these yield curves than it would be with more samples in younger age classes.

There is a need to establish permanent sample plots in many species, sites, age classes and biogeoclimatic zones in the Province to determine the "growth" characteristics of the forest in each region. Validated growth trends from these plots will not be available for use until sufficient remeasurement has taken place.

Different yield functions have been used for yield analysis in the Province. The results of using different yield curves for the same forest management unit are often dramatic. There does not appear to be a process, containing sufficient samples, to validate or test the different curves being used.

The MOF is currently developing new natural stand yield equations and should be encouraged to give priority to their completion.

It was expressed in all of the reviews that it was unfortunate that the MOF had not captured the potential for supplementing the mature volume sampling by using operational cruise data supplied to them "free of cost" by the forest industry and their own cruises.

In order to provide a relative measure of the reliability of the inventory volume prediction, each consulting firm made case study examinations of the volumes cruised and harvested from specific areas. The results were inconclusive. Comparisons of this nature would be meaningful if done at the management unit level on an annual or longer term basis. The MOF does not do any operational monitoring of inventory volume predictions.

C. Recommendations

7. ***A program designed to expand the sample plot program to fill the gaps in the existing data base must be started immediately, particularly in the younger age classes.***

EXHIBIT 3. DISTRIBUTION OF DECAY SAMPLES USED TO GENERATE LOSS FACTORS APPLICABLE TO FORT ST. JOHN TSA

SPECIES	TOTAL DECAY SAMPLES	SAMPLES IN FT. ST. JOHN TSA		SAMPLES IN FIZ "L"	
		Number	%	Number	%
B	5 600	0	0	73	1
S	7 840	799	10	2 121	27
Pl	7 329	472	6	1 031	14
L	1 288	32	2	153	12
Ct	735	44	6	592	81
Bl	727	5	0.5	303	42
At	1 815	490	27	1 083	60
Total	25 334	1 842	7	5 356	21

8. ***A permanent sample plot program designed to provide reliable growth and yield functions must be instituted in both natural and managed stands.***

9. ***Procedures for incorporating the operational cruise data with provincial inventory data bases should be developed and implemented. It should be linked with a program of monitoring inventory volume predictions with operational cruise volume estimates and harvest depletion volumes.***

4.1.4 Decay, Waste and Breakage Loss Factors

Standing volume and growth volume estimates are reduced for decay, waste and breakage to more accurately reflect the merchantability of the timber crop.

A. Issues

Is the sampling date, location and distribution of loss factor sample plots appropriate for timber inventory and yield analysis today?

Is the calculation of loss factors for a Forest Inventory Zone (FIZ) appropriate to use for a TSA yield analysis?

B. Observations

The greater percentage of loss factor plots were established between 1954 and 1962.

Concern was expressed that the distribution of samples may not provide adequate data for today's use. As seen in **Exhibit 3** (opposite), only 7% of the samples used to derive loss factors for the Fort St. John TSA are located within the TSA and, only 21% are located within the appropriate FIZ.

The Sunshine Coast TSA study found that only five plots were located within the boundaries of the TSA. Four of these, established in 1954, were grouped in an area that is not representative of current timber harvesting activities.

There was wide consensus that the existing loss factors are not reliable due to:

- Inappropriate aggregation from large areas;
- Insufficient samples located in the management unit;
- Poor coverage of species and biogeoclimatic zone;
- Relationship between sample locations and current harvesting areas.

The MOF has recently proposed some new initiatives to refine and improve the loss factor analysis system. While the current process of data collection is time consuming and financially onerous, the data is essential. Some TFL holders have developed their own loss factors for their particular management unit.

C. Recommendation

10. Strong support should be given to the current MOF initiatives to improve the provincial loss factor system. It requires establishing priority sampling areas and the compilation of the new data.

4.1.5 Site Index

Site index is a measure of the productive capacity, in terms of timber growth, of a tract of land. It is a major determinant in growth projections, and thus resultant yield analysis.

A. Issues

Is polygon classification reliable enough to accurately label site index?

What are the effects on the yield analysis process of not having the productivity of the site labelled correctly?

Can silvicultural management opportunities be properly investigated in the yield analysis process with the current site index data base?

Is the site index labelling sufficiently accurate to label polygons in "low" site classes that may remove them from the land base used in the yield analysis process?

EXHIBIT 4. AREA BY SITE CLASS WITHIN AGE CLASSES FOR THE GOLDEN TSA

AGE CLASS	SITE CLASSES - AREAS IN HECTARES			
	Good	Medium	Poor	Low
1	3 463	1 141	2 538	4 343
2	2 124	625	2 176	3 117
3	1 571	4 051	10 950	182
4	7 617	17 215	6 191	415
5	12 739	14 469	6 318	149
6	7 708	8 178	2 614	0
7	1 291	3 600	1 192	7
8	3 722	17 259	33 715	10 804
9	4 732	10 394	25 508	10 433

B. Observations

The individual reviews indicate that often less than 10% of the older age class polygons have measured data (refer to **Exhibit 1**). It is questionable whether the current inventory data base is sufficiently sampled and accurate to define site quality to the degree of precision required for reliable yield analysis. The removal of low site class areas from the analysis process is based upon polygon labels. If the majority of the polygon labels are incorrect, the yield analysis results are also compromised.

The inventory procedure for converting age, height and site class designations to actual age, height and site index is not capable of reflecting these parameters accurately. The use of class values and their subsequent conversion to mid-point ages, heights and thus site has provided actual values but has NOT improved the classification.

Exhibit 4 (opposite) was developed for the Golden TSA. It appears that the process used in this case has skewed the younger age classes into higher site classes and the older age classes into lower site classes. The review of the Fort St. John TSA indicated that site indices calculated from class based attributes can deviate from those calculated from real height and ages by as much as ±25%.

The impact of such a variance in site index determination on yield analysis, particularly the procedure used by the MOF, is dramatic. For example, using the stocking level of 1110 stems per hectare for coastal Douglas-fir, as is consistently used in MOF yield analyses for managed stand yields, results in a range in CMAI of as much as 7.0 m^3/ha/yr within the medium site class. This range is found in the MOF's own growth model and in two other commonly used growth models for coastal forests.

It is essential for strategic planning of timber supply opportunities to accurately know the productive capacity of the land base within the management unit. The opportunity to investigate the effects of various silvicultural treatments on LRSY and ultimately on the AAC are severely restricted by not having reliable site index classifications.

The MOF has very recently initiated some work to refine the height curves used for site index classification and is looking at narrowing the interval in site classes used in the inventory.

EXHIBIT 5. AVERAGE FREQUENCY OF CHANGE IN INDICATED FOREST COVER ATTRIBUTE BASED ON FIELD SAMPLES[1] FROM THE FORT ST. JOHN TSA

FOREST TYPE	TYPE GROUP[2]		AGE CLASS[3]			HEIGHT CLASS[3]			SITE CLASS[3]		
	C	I	C	O	U	C	O	U	C	O	U
Aspen-coniferous	35	65	50	45	5	60	10	30	25	55	20
Pure deciduous	70	30	50	30	15	60	10	30	60	5	35
Leading coniferous	35	65	40	30	30	NA	NA	NA	50	25	25
NSR/NCBr	20	80	NA[4]	NA	NA	NA	NA	NA	NA	NA	NA

[1] Field sampling as reported by D.R. Systems, 1988 and ground calls established by I.F.S. as part of current reinventory

[2] C = correct type group, I = incorrect type group

[3] C = correct class value, O = overestimated class value, U = underestimated value

[4] NA = Insufficient Data

C. Recommendation

11. The design of the timber inventory system must provide for more ground sampling to reliably estimate the site productivity.

4.1.6 Deciduous Inventory

Interest in deciduous inventories has increased dramatically in recent years in parallel with the increased interest in deciduous species for commercial purposes. Management unit AAC's have, in some cases, doubled with the inclusion of the deciduous land base into the analysis procedures.

A. Issues

Is the net land base used for yield analysis involving deciduous species correct?

Do the growth projections applied to 15-20 year old inventory data accurately account for stand dynamics in mixed deciduous/coniferous stands to reflect today's conditions?

Is the current mixed deciduous/coniferous data base accurate enough to be able to conduct a reliable yield analysis?

B. Observations

Exhibit 5 (opposite) depicts the results of a study done in the Fort St. John TSA of 785 samples. Only 35% of the mixed deciduous/coniferous stands are labelled correctly for type group. The combination of overestimating age and underestimating height will have significant impact on site class, CMAI and ultimately yield analysis.

The same study indicated that 99% of the reported NSR was stocked to commercial species, mainly aspen, and over 50% of the NCBr was stocked. The draft TSA Plan states there is 133 400 ha of NSR and 264 800 ha of NCBr. If these hectares are left out of the TSA yield analysis, the impacts are very significant.

EXHIBIT 6. SUMMARY OF PROBLEM FOREST TYPE REDUCTIONS
FORT ST. JOHN TSA

	CONIFEROUS	DECIDUOUS	TOTAL
Productive Land Base Net of NSR, DSD, ESA's Right-of-Way and Low Site	1 045 811	581 126	1 626 937
Reduction for Problem Forest Types	(648 800)	(33 000)	(681 800)
Net Merchantable Land Base	397 011[1]	548 126	945 137
Percent Reduction for Problem Types	62%	6%	42%

[1]Prior to the addition of 98 100 ha of coniferous stands as a result of an intensive silviculture program schedule over a 30-year period.

Exhibit 6 (opposite) shows the area net downs for coniferous and deciduous types in the Fort St. John TSA. The coniferous land base has been reduced by 62%, while the deciduous land base is only reduced by 6%. This situation needs review prior to finalizing the TSA Plan.

The MOF currently has initiatives to improve the mixed deciduous and coniferous inventories in the NE portion of the Province.

C. Recommendations

12. ***Strong support should be given to the MOF initiatives to improve the mixed deciduous/coniferous inventories in the NE portion of the Province.***

13. ***Coniferous area inclusion factors should be applied to deciduous types until experience in the utilization of these types is developed and can be used in defining the net land base of this timber component.***

14. ***If the apportionment and commitments to harvest remain separated for coniferous and deciduous forests, then the yield analysis should also be evaluated separately.***

4.1.7 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESA's) were introduced into the inventory and yield analysis process to account for and protect other forest resource values such as soils, water, wildlife and recreation in their determination of an AAC.

A. Issue

Do ESA's, and the classification process, adequately reflect all forest resource values for planning and yield analysis?

B. Observations

Many of the original ESA's were established in the late 1970's on both TSA's and TFL's and tended to be subjectively classified, often from aerial photos, without adequate ground confirmation.

C. Recommendation

15. The establishment, planning and management of environmentally sensitive areas should be based on the total forest resource inventory data base and the management strategies for the management unit. This needs to be reviewed and incorporated into re-inventory plans of the MOF.

4.1.8 Timber Inventory Data Base and Data Management

In order to conduct sound timber management planning, there must be both precision in the data bases used and an appropriate data management system.

A. Issues

Is there basic precision and quality of the timber resource inventory and management data to meet today's and future resource management needs?

Is there quality assurance/quality control systems in place to ensure the integrity of the data bases?

There is rapidly increasing use of MOF timber inventory (EGAF and FIP) files by outside groups; is there consistency in the data bases being released?

B. Observations

It is essential to upgrade the general precision and reliability of the timber inventory and associated data bases. The present inventory is not designed for, and therefore will not support, polygon level analysis.

The MOF has spent a large sum of money digitizing the present stratification of the timber resource and linking the present data base in a GIS. Since GIS systems are designed to be polygon level specific analysis tools, it is essential that the inventory be upgraded sufficiently to support GIS analyses before the results of these analyses are widely used. The need for polygon level planning is here now and will only increase in the future.

MOF staff have to contend with generally weak statistical data and difficulties in resolving differences or changes in data sets. These two problems have been confused. It is essential that the MOF plan and be given the budgets to upgrade the basic resource inventory information. It is also essential that an overall quality assurance/quality control program be put in place.

Many MOF files are "dynamic". They are revised on an ad hoc basis without an overall functional system of quality assurance/quality control. As a result, some basic, foundation level data is frequently corrupted. The reconciliation process is expensive, time consuming and unnecessary. A quality assurance/quality control group and system is needed to ensure standards of definition and compatibility within and across data bases, provide transaction-based control of the data update/change process and provide version and release date control of all major data bases.

Each resource on a 1:20 000 scale map sheet requires a data set of roughly 1 million bytes of information in graphics and 300,000 bytes in associated text files. This data needs to be frequently updated and backed up. Assuming the average forest management unit covers 60-100 mapsheets, there must be the capability to manage on a routine basis 240 million to 1 billion bytes of information over more than 200 files. This is not a simple nor inexpensive task. There is concern that the MOF is not prepared both in people skills and infrastructure to manage such a decision-support system.

C. Recommendations

16. A quality assurance/quality control group and program for data management be established within the MOF immediately.

17. The MOF must establish "official" release-dated versions of their major data files. These files would be the official data sources for planning and analysis work until the next issued "official" file.

4.2 YIELD ANALYSIS

4.2.1 Inventory Land Base Reductions

One of the most sensitive assumptions in yield analysis is the level of operable land available for timber management within the management unit.

A. Issues

Are the reductions for the land base used in the yield analysis process appropriate to the forest resources on the management unit?

Is the derivation of the reductions based on inventory data or subjective interpretations of a committee?

B. Observations

Due to the lack of date-released EGAF and FIP files, different versions of operable area exist for TSA's. This causes confusion and complications for users.

It is difficult and frequently not possible to reconcile differences in net area determinations due to the dynamic nature of the data base files.

Typically "low" site class areas are removed from the yield analysis. As seen in the discussion in Section 4.1.5, this may lead to the incorrect net land base for analysis. Reclassifying "site class" following the release of new site index curves removed an additional 11 000 ha from the Sunshine Coast TSA and 7 800 ha from the Golden TSA.

There is not consistency in the netting down criteria and process between forest management units in the Province. The Sunshine Coast TSA review compared operable areas of TFL's within the boundaries of the TSA. The conclusion was the TSA had about one half the operable percentage the TFL's had for the same geographic area.

Reductions for roads, trails and landings were not always included in the netting down of the productive land base. There appears to have been inconsistent recognition of the potential for site degradation from harvesting.

The determination of net downs for ESA's often appeared to be subjective rather than based on real data.

NSR area is handled inconsistently. Large areas are added to or deleted from the net land base with very little or no documentation. The exclusion of NSR area from the net land base needs to be critically reviewed in terms of its impact on LRSY and AAC determination.

The MOF definition of "productive" forest land is largely subjective. There are few quantitative or objective criteria defined to assist this process, yet determination of the productive and net productive land base is a key item in the yield analysis process.

It is not possible to estimate the long term land base by simply using current operating and economic conditions. Assumptions must be made about a number of economic factors which are very dynamic. As a result, the current length of time taken for yield analysis in TSA's may outdate the net down criteria used in the analysis.

C. Recommendations

18. The MOF must develop a process that can objectively define the term "productive forest land" for each TSA and TFL.

19. Consistent procedures must be developed to derive the net down of the productive land base. If there is variance to the procedure, it must be documented. Release-dated files should be used during the yield analysis process.

4.2.2 Not Satisfactorily Restocked Areas

Not satisfactorily restocked (NSR) areas are those that do not contain a sufficient number and distribution of acceptable species. In MOF yield analysis procedures, large areas of NSR are often removed from the net operable land base used in the calculation.

A. Issues

Should NSR areas be excluded from the yield analysis?

How do you reconcile differences in the MOF Inventory Branch's NSR statistics and Silviculture Branch history record NSR statistics and why do these differences exist?

B. Observations

The exclusion of NSR area from the LRSY analysis is incorrect. Current inventory status does not impact the LRSY. LRSY is simply a measure of the yield resultant from a management regime applied to the productive capacity of a particular forest estate. The impact of NSR area on the LRSY should be handled through the correct modelling of regeneration delays.

The discrepancies in NSR area statistics derived from inventory files and silviculture history record data base may result from the differences in labelling species acceptability.

The process of how the differences in the data of these two systems is reconciled is not documented.

C. Recommendations

20. In future yield analyses, NSR areas should be included in the net productive area with appropriate regeneration delays and yield tables.

21. Document the reconciliation of Inventory and Silviculture Branch records in the yield analysis process. The dual record keeping of NSR statistics by MOF Inventory and Silviculture Branches should be structured in a compatible format.

4.2.3 Problem Forest Types/Area Inclusion Factors

Once the productive land base of a management unit is defined, "problem" forest types within that productive land base are netted out for the yield analysis. This is most typically done by a multiplier called an area inclusion factor (AIF).

A. Issues

Is consensus at a TSA Steering Committee Meeting an objective way to identify problem types?

Is there consistency in the protocol for developing AIF's used in management units within similar geographic areas?

B. Observations

Consensus in large committees is not an appropriate way to derive AIF's. This rather arbitrary approach results in different and often contrasting AIF's for management units within similar geographic areas.

Problem types are not always uniformly distributed in TSA's between licensees. Therefore, it may be difficult to relate to the spectrum of problem types in the whole TSA and come to decisions about AIF's by a committee made up of these licensees.

As discussed in Section 4.1.6 and seen in **Exhibit 6**, the AIF's for the deciduous forest types in the Fort St. John TSA are in need of immediate review. The coniferous forest type AIF's were considered likely to be conservative.

C. Recommendations

22. ***It is essential that a process for determining area inclusion factors based on objective criteria be developed.***

23. ***Definition of problem forest types should be based on historical harvest profile and current definitions of merchantability. Monitoring of these areas should be continuous and the yield analysis process flexible and responsive to timely change if required.***

24. ***The yield analysis process should include a complete examination of the sensitivity to the LRSY from different inclusion factor options, including consideration of future timber utilization potential.***

4.2.4 Aggregation of Forest Types

It is difficult, and often not necessary, to model each individual stand in the yield analysis for a management unit. Accordingly, similar stand types are aggregated for the yield analysis process.

A. Issues

Is the constraint of the number of analysis units allowed in the MOF's forest estate model (MUSYC) biasing the yield analysis?

Does the aggregation process recognize the silvic characteristics of the aggregated species, particularly by site, and thus the silvicultural management opportunities?

Does the aggregation process recognize the size of the management unit and the variations of growth and yield that might be found in that unit?

B. Observations

Statistically, the aggregation process the MOF uses is reported to be correct. However, it can be, and often is, biometrically incorrect.

The limited aggregated units used by the MOF is an artifact of the software the MOF uses. Other commercially available yield analysis models do not require this level of aggregation.

The impact of silvicultural enhancement to yield opportunities can be severely limited or distorted by aggregation of species and site classes.

The reality and timing of operational harvest opportunity is lost in the aggregation process.

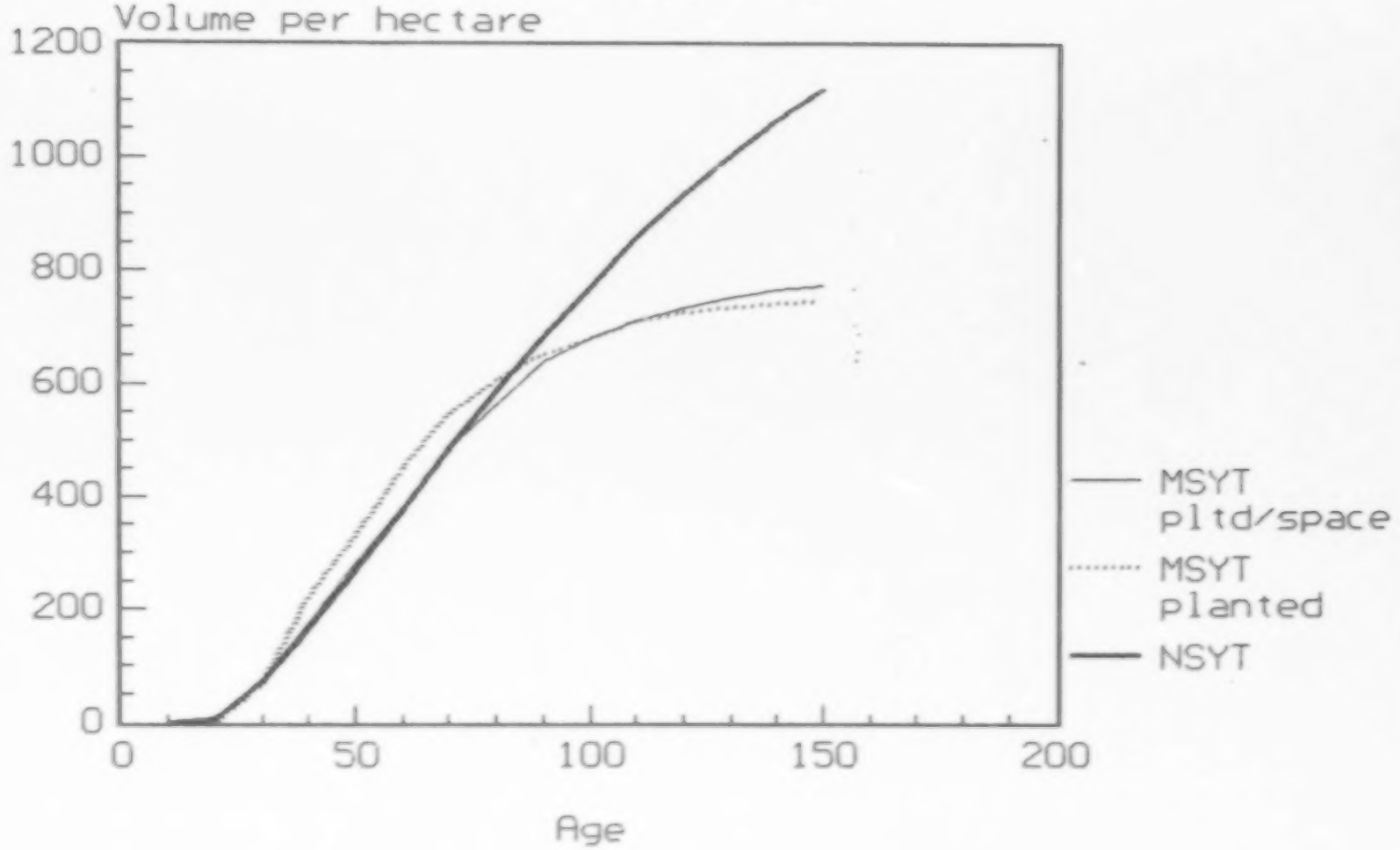
C. Recommendations

25. ***The MOF should immediately look at the use of yield analysis software that does not require the current aggregation limits.***

26. ***The aggregation process must consider what is biometrically and statistically correct within species and between species.***

EXHIBIT 7

Natural and Managed Stand Yield Tables used in the Sunshine Coast TSA Analysis Good Site Douglas-fir



4.2.5 Managed Stand Yield Tables

Sound forest management planning requires analysis of both the biological and financial opportunities within a management unit. The critical "tool" in these analyses is stand level growth models.

A. Issue

Do managed stand yield tables exist for all major commercial species in the Province?

Is the opportunity to analyze silvicultural yield increase opportunities available?

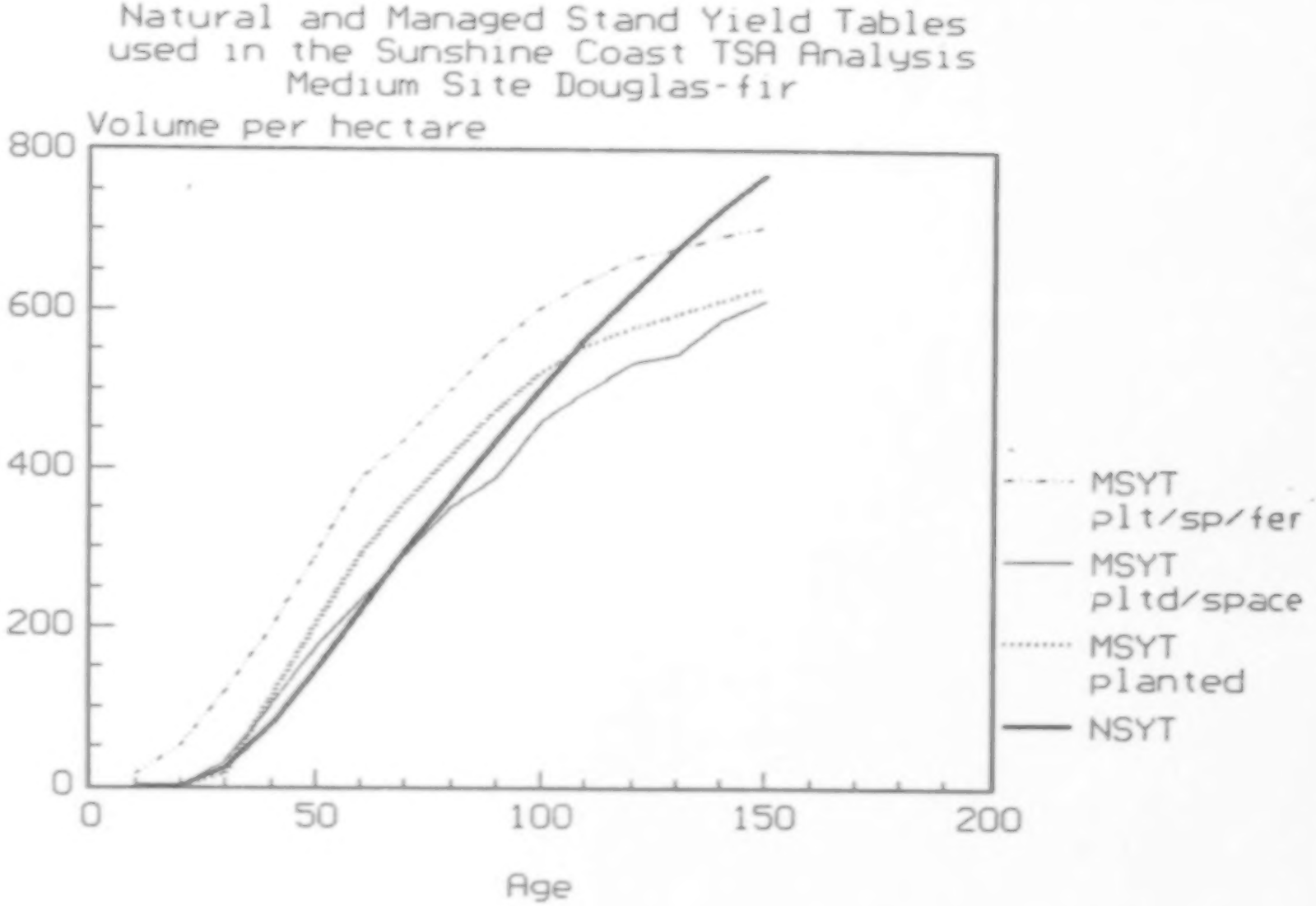
Are the natural stand yield tables used in the analysis compatible with the managed stand yield tables?

B. Observations

Managed stand yield tables used by the MOF are currently limited to two species, Douglas-fir on the coast and lodgepole pine in the interior. This appears to be a result of the MOF only being willing to use their in-house growth model. Other regional managed stand yield tables exist for many if not all of the major species in the Province. It would appear obviously advantageous for the MOF to make use of them. It is indefensible to knowingly restrict silvicultural and forest management options simply because an in-house growth model has not yet been developed. The MOF focus has been much too narrow.

Exhibits 7 (opposite) and **8** (overleaf) illustrate graphically the relationships of the natural and managed stand curves used for the Sunshine Coast TSA yield analysis. Clearly, there are technical differences between these functions. At harvest ages used in the analysis, significantly more volume is achieved on the natural stand curve than on the managed stand curve. There appears to be no apparent advantage from spacing (using a 17.5 cm merch dbh). Fertilization is depicted as a 90 m^3 response that is incremental to the planting curve for the total length of the curve. This response is critically questioned.

EXHIBIT 8


Natural and Managed Stand Yield Tables
used in the Sunshine Coast TSA Analysis
Medium Site Douglas-fir
Volume per hectare
800
600
400
200
0
0
50
100
150
200
Age
MSYT
plt/sp/fer
MSYT
pltd/space
MSYT
planted
NSYT

No silvicultural response to any species other than Douglas-fir or lodgepole pine can be measured in MOF yield analysis. No matter what is said in silviculture management options or actually done in management activity, only the natural stand yield curve is used. In short, no matter what regimes are planned or implemented the growth response to silvicultural treatment on these other species in the MOF procedure of yield analysis is zero.

Some TFL holders have developed their own growth models or "localized" existing growth models.

Yield analysis with a planning horizon greater than 30 or 40 years is based from that time on, totally on yield functions. If there are no reliable, validated growth models for silvicultural treatments and regimes being "applied" in the analysis, how can the results be considered valid or reliable?

Stand level yield results and growth patterns are often different between growth models. These differences reflect the data sets used to develop the model and the scientific approach of the individual scientists who developed the model. It is therefore desirable to have more than one model for a species to appreciate these differences and to develop an understanding of the sensitivity of the differences to the results of a yield analysis.

C. Recommendation

27. ***The MOF must immediately begin the process of acquiring and calibrating external, successful, regional natural and managed stand growth models. These models should then be used in planning, forecasting and analysis for all major commercial species in the Province.***

4.2.6 Other Yield Analysis Assumptions

By its nature, yield analysis is largely based on assumptions. The results of a particular yield analysis are directly related to these assumptions. The impacts on results of individual assumptions, and combinations of assumptions, vary over the complete spectrum of very low to very high.

A. Issue

Do the assumptions used in the yield analysis process for, harvesting, silviculture and others seem to be appropriate and reasonable?

B. Observations

Very little if any sensitivity analysis is done around the numerous assumptions that are required in a yield analysis.

There appears to be very little monitoring of the assumptions used to see how appropriate they are to operational practises and results.

Operable land bases appear to have been established with very little resource inventory information and objective rules of assessment. None of the yield analyses done to date are geo-referenced and therefore it is not possible to determine whether or not harvest opportunities presented in the MUSYC model are feasible. Typically, information on where the harvest is coming from in terms of species and site class is not available.

Very little effort has been spent defining the preferred biological and financial stand level treatments to achieve specific forest level goals.

The use of CMAI to determine harvest age rather than a financial or merchantability criteria negates most, if not all, of the potential benefits from incremental silviculture.

Silvicultural regimes modelled in TSA analyses do not reflect what is actually happening in the field nor do they attempt to address impending fibre supply shortages seen in the MOF analyses.

MOF yield analysis objectives of 10% decline per decade and a "regulated" forest after 200 years is in some cases imposing lower harvest levels less than are sustainable. A normal distribution of age classes will not result in an even production of fibre due to differences in site and density throughout the management unit. Biological and economic sacrifices continue to be made in our preoccupation with a regulated forest.

C. Recommendations

28. ***Sensitivity analyses of the assumptions used in the forest estate model must be done as an integral part of the yield analysis and AAC determination process.***

29. ***A monitoring program that will allow investigation into the operational validity of the assumptions used in the model must be implemented as one aspect of an overall quality assurance/quality control program.***

4.2.7 Yield Analysis Process/Forest Estate Models

The yield analysis process and the forest estate model used can affect the results of the analysis, the efficiency in achieving the results and the accuracy of the results.

A. Issues

Does the yield analysis process integrate information on resources effectively, efficiently and correctly?

Is the process repeated frequently enough to be able to react to changing resource values?

Is the forest estate model(s) being used effectively, efficiently and correctly?

B. Observations

Forest resource inventories are not adequate to do the kind of reliable resource planning required today and in the future.

Individuals can work extremely hard and conscientiously on a planning analysis. They can do everything correctly with respect to procedure and process, but if the original inventory is very weak and there are no validated growth forecasts for the second growth forests being created and managed, it is impossible to develop a reliable yield analysis and recommended AAC.

EXHIBIT 9. CURRENT STATUS OF TSA YIELD ANALYSIS PLANNING SINCE ALL PLANS WERE COMPLETED IN 1984
(as of July 20,1990)

ACTIVITY IN YIELD ANALYSIS PROCESS	NUMBER OF TSA'S
No action to date	7
Issues, Options Report	7
Information Report	3
Analysis Report	8
Options Report	6
AAC Documentation	1
New TSA Plan	3
Total	**35**

The yield analysis process is far too protracted and time consuming. Issues and options can become outdated before they are analyzed. All TSA's had their initial yield analysis work completed between 1982 and 1984. It is MOF policy that AAC's for TSA's will be determined every five years or sooner. Since that time, as shown in **Exhibit 9** (opposite), only 4 TSA's out of a total of 35 in the Province have had AAC's redetermined based on a new yield analysis.

The use of a single optimization model and modelling process is restricting options and sensitivity analysis. The MOF will have to initiate use of a different modelling technique to capture the capability of GIS in their planning efforts.

Regional and District planning staff in the MOF do not currently have direct access to stand or forest level models and are not responsible for doing yield analysis.

There is concern about what is "optimal" over a 200-250 year planning horizon, considering MOF policy and goals.

Simulation models are much more easily understood. They allow for sensitivity analysis of the assumptions.

Current MOF MUSYC results are constrained to the LRSY resultant from the inventory and yield curves used. This may not represent the true available fibre supply.

Interpretations are limited by the lack of biological, financial and economic impact analysis, lack of strategic fibre supply planning and the lack of geo-referencing. Prior to geo-referencing, it will be necessary to significantly improve the resource inventories and associated data bases.

Better understanding and communication of the impacts of yield analysis on fibre supply is required within the MOF between groups supplying information to the yield analysis process and those responsible for running the model. If the responsibility for yield analysis and preparing a TSA Plan was vested at a District level, the efficiencies gained would allow plans to be prepared every five years or updated earlier if required.

C. Recommendations

30. A subcommittee of the Forest Resource Inventory Task Force should review the analysis process in view of the need to improve the information used, and to adopt more efficient and effective procedures. The review must include reducing the time it takes to complete a TSA Plan. This task should be completed, and the recommendations implemented with the next 12 months.

31. The MOF adopt the use of stand and forest level simulation models to do yield and sensitivity analysis at the Regional and District level. Once this initial work has been done at the Regional and District level, Integrated Resources Branch would review the analysis for completeness, consistency and compatibility.

4.3 ASSESSMENT OF ALLOWABLE ANNUAL CUT

The determination of the annual harvest level or AAC is linked to the harvest forecasts derived from the yield analysis process. The determination of an AAC is a management decision supported by yield analysis that can, and often does, encompass many other factors. It is the culmination of a complex planning process.

A. Issue

Have the AAC's of the management units been determined in an appropriate manner?

B. Observations

All of the management units reviewed have an AAC based on a timber yield analysis. The AAC levels chosen appear to reflect the forest conditions of each unit. The specific findings from the review of each management unit are as follows:

Golden TSA - AAC 650 000 m^3/year

The AAC is 40% higher than the indicated LRSY of 466 750 m^3 per year. The current AAC is sustainable for 30 years, after which time it must decline to the indicated LRSY over a period of 50 years. The AAC rationale suggested this decline could be offset by a greater utilization of decadent hemlock types, an expanded operable area and by reforesting 10 700 ha of NSR. No sensitivity analysis was done to quantify these potential impacts and it is noted that there is insufficient data available to determine yield increases from incremental silviculture. The confidence limits of the yield analysis result are stated to be ±30%.

Sunshine Coast TSA - AAC 1 445 000 m^3/year

The Sunshine Coast TSA was established in 1986 when the MOF made a major revision to all the boundaries of the TSA's in the lower Vancouver Forest Region. The existing AAC's were reallocated based on the new boundaries. A technical yield analysis has not been completed for the TSA. A new analysis for the Sunshine Coast TSA commenced in August 1986 and after four years was at the Options Report phase at the time of this study.

If there were weaknesses in the previous yield analysis, they have been carried over to the existing AAC determination. The consultant noted several weaknesses in the current yield analysis process and data. Until an AAC is determined, resultant from a yield analysis for the TSA, no conclusions should be made.

Quesnel TSA - AAC 2 935 000 m^3/year

The Quesnel TSA is one of the largest TSA's in terms of AAC in the Province. The AAC rationale indicates a base level AAC of 2 000 000 m^3/year be established, which is acceptably higher than the LRSY of 1 670 000 m^3/year. The approved AAC was set for a two-year period (August 1990 - July 1992). It allows a harvest of 400 000 m^3 in problem forest types and 50 000 m^3 for deciduous types and includes an allowance for the proposed TFL 52.

The consultant considered this two year interim AAC an expedient short-term solution to a number of timber management problems in the TSA. It was stated that main issues have not been fully analysed and the MOF has another two years to complete the job.

Fort St. John TSA - AAC 1 815 000 m^3/year

The AAC has two components: coniferous, 900 162 m^3; and deciduous, 915 000 m^3. Both levels are slightly below the indicated LRSY.

The consultant considered the coniferous AAC to be slightly conservative and sustainable. An expanded intensive silviculture program and NSR back log reforestation would allow for an increased AAC.

Conversely, the deciduous AAC appears to be overestimated. Little consideration was made of the economics of harvesting deciduous timber; virtually all deciduous stands were included in the net productive land base.

Tree Farm Licence No. 35; Weyerhaeuser Canada - AAC 88 000 m^3/year

The TFL holder has completed a new yield analysis report and has requested the Chief Forester's approval for an AAC of 125 600 m^3/year. This is a 40% increase over the existing AAC of 88 000 m^3/year and required close scrutiny and justification.

The consultant found that the yield analysis and proposed AAC increase had been subject to a detailed technical review by the MOF. The premise for the increase is dependent on the TFL holders' intention to carry out enhanced forest management and the use of new managed stand yield projections.

The supporting yield analysis has been carried out appropriately, with defensible inventory deductions and realistic management assumptions. **The consultant concluded that the results form an adequate basis to determine the AAC.**

The MOF will permit the AAC increase to take effect after allowing the TFL holder a two-year period to demonstrate implementation of their management strategy.

Tree Farm Licence No. 6; Western Forest Products - AAC 1 300 000 m^3/year

The currently approved AAC in effect until 1991 is 25% above the indicated LRSY of 1 076 000 m^3/year calculated in the latest yield analysis.

The consultant review indicates that there may be future adjustments to the mature inventory volume and to the yield functions used in the yield analysis. It was noted that the total productive forest area was assumed to be operable, which may be optimistic. The methods used to carry out the yield analysis were reviewed and found to be appropriate. The TFL holder's management strategy proposes to reduce the AAC by 30 000 m^3 each five-year period until the year 2026, when it will level off to 1 076 000 m^3/year. It was found that the proposed allowable cut is reasonable and supportable, based on using the available site curves and yield data. **The consultant concluded that the proposed AAC is proper, and can be supported during the next few decades.**

Tree Farm Licence No. 51; Westar Timber - AAC 110 000 m^3/year

The AAC level has been temporarily high (compared to LRSY) due to the need to salvage harvest spruce and lodgepole pine types damaged by bark beetle infestation. The current AAC of 110 000 m^3 is now below the indicated LRSY of 120 000 m^3/year. **The consultant's review considered that this AAC level is conservative but justifiable.** Any increase in AAC in the future should depend on the successful outcome of the forest management practices and reliable yield forecasts.

The reviews of these seven management units convinced the Consortium that the proper procedures had been followed for determining the respective AAC using the best information available. None of the consulting firms found that the AAC levels were too high. Certainly,

MOF staff have done their very best to determine AAC levels, considering the lack of resources and budgets to do the job.

The findings illustrate that each management unit is different and unique. AAC has to be determined specifically and appropriately, according to the individual management strategies and assumptions for each management unit in the Province. Forest resource management planning must address a balance between social values and social costs. There are a spectrum of timber supply opportunities presented in each forest management unit which is unique to the forest types and land base within the unit.

Little strategic planning takes place to define these opportunities both biologically and economically. The result is that today's management activities are not focused on strategies designed to alleviate potential declining harvest levels. Any changes from current AAC levels should be made within the context of a strategic fibre flow plan for the management unit.

There tends to be a conservative approach taken in determining the AAC for TSA's. However, due to the weaknesses in the inventory data base and the number of subjective management assumptions made in the yield analysis, there is a generally low level of confidence in the appropriateness of current AAC levels.

The same observation can be made with respect to the three TFL's reviewed. However, we cannot be sure this applies to TFL's generally. For TFL's that have a higher level inventory, localized yield functions and a more detailed yield analysis, there will be more confidence in the AAC.

No suggestion of political interference or unwarranted adjustments in the determination process were found. If the public wants stronger emphasis placed on integrated use of the forest resource, it raises the question as to whether the present yield analysis and AAC determination process under the authority and guidance of the MOF is appropriate. This process should be reviewed to determine if changes are necessary. A more formal role for government resource agencies and community groups in determining the AAC level may minimize resource conflicts and develop consensus. This would be included in the review by the Forest Resource Inventory Task Force subcommittee recommended on Page 45, Recommendation 30.

If significant changes to AAC levels are made which cause economic and social disruptions without at first taking the actions recommended, the changes are not defensible.

C. Recommendation

32. ***Significant changes from current levels of AAC should not be made until there is a more accurate inventory data base and an improved yield analysis process which clearly demonstrate that adjustments are justified. Any changes should be made within the context of a strategic fibre-flow plan for the management unit.***

APPENDIX A

TERMS OF REFERENCE FOR CONSULTING FIRMS

TERMS OF REFERENCE FOR CONSULTANTS

The key objectives set out the basis for the Terms of Reference for consultants. More particularly the consultants were guided in their task by a statement of the scope of the proposed study and by a prescribed outline. The idea of constraining the consultants to fairly rigorous format was to ensure ease of comparison of the reports and to prevent the consultants deviating too far from the specified study area in a field which is very complex and has numerous closely associated functions.

The full text of the Terms of Reference can be supplied; however, the section that outlined the scope of the study is reproduced below:

> The technical content of each study report will be the responsibility of the appointed consultant, based on the project outline submitted by the Commission. The study teams will not be conducting an audit or an in-depth analysis, but a technical review. The Commission does not consider that any field examination should be carried out at this time. The scope of this technical review requires the study teams to check the basis of data and procedures resulting in the current AAC level of the study area assigned. From this information, professional judgement should be applied to provide conclusions as to the accuracy and appropriateness of the inventory, and AAC, and make recommendations for improvements.

The tasks set for the HST Consortium, the co-ordinating team were to:

- Refine the specifics of the Terms of Reference to ensure all prospective consulting firms would be bidding to well defined criteria;
- Review proposals submitted by invited consulting firms;
- Recommend consulting firms to undertake the studies;
- Arrange for information meetings with members of the Commission and with the Ministry of Forests;
- Co-ordinate and monitor the progress of consultants;
- Review and analyze consultant reports;
- Prepare an overview report for the Commission summarizing the findings of the consultants and specialist consultants.

APPENDIX B

EXECUTIVE SUMMARIES FROM CONSULTING FIRMS' REPORTS

Forgis Resource Consultants Ltd.

EXECUTIVE SUMMARY

Introduction

This report, undertaken for the British Columbia Forest Resources Commission, provides a technical review of the Forest Inventory and Allowable Annual Cut for the GOLDEN TSA.

At the onset it must be stated that:

1. The inventory was conducted to 1968 specifications which were designed to meet the needs at that time.

2. The Timber Supply and AAC were initially conducted in 1981 to specifications and standards in effect at that time, and

3. The nature of demands on the land base, information requirements and management objectives have changed significantly from those at the time of the inventory and Timber Supply Analysis.

These factors have contributed to many of the concerns regarding the Inventory, Timber Supply and AAC.

During the course of the review we were very impressed with the degree of knowledge, commitment and dedication exhibited by the people involved in both the Inventory and Timber Supply Analysis.

Review Objectives

For the purpose of this study the Forest Inventory and Timber Supply Analysis procedures, information and results were reviewed in the context of past and current forest management requirements.

Identified Shortcomings

Based on the evaluations of the Inventory and Timber Supply Analysis, a number of areas which have the potential for significant improvement are documented and possible courses of action to implement these improvements are outlined.

Forest Classification

The current forest classification was designed to provide Unit Level inventory estimates. This is no longer adequate in terms of current information requirements. The inventory must have the capability to provide stand-specific estimates. This will require collection of such parameters as:

- Species per cent;
- Actual stand height and height distribution;
- Actual stand age;
- Density in terms of basal area and/or stems per hectare;
- Stand diameter and diameter distribution;
- Log grade and quality; and
- Revision of ESA's.

Yield Estimation

The yield estimation procedures should allow more precise and accurate estimates of gross and net volume and log size and quality. They should be capable of estimating parameters on a stand-specific basis.

Data Access

The capability of Districts to access and report on inventory statistics and timber supply analyses is limited. Local Regional and District data summary capabilities addressing local needs should be available.

Other Resource Values

Insufficient emphasis was placed on the inclusion of resource values in the past.

Rationalization of NSR Statistics

Both Inventory and Silviculture maintain information on NSR through two different reporting systems which report different statistics.

Operational and Strategic Planning Needs

The current Timber Supply Analysis System addresses strategic planning needs and does not address the needs of operational managers. The system should allow the determination of timber supplies and AAC by local units and be capable of addressing geo-referenced stands and monitoring adherence to the TSA Plan.

The current system has become too complex and involved.

Aggregation Procedures

The demonstrated volume variances associated with aggregation will always exist. It is an artifact of a system restriction and results in the inappropriate treatment of data.

Net Down Procedures

Checking procedures for the allocation of net downs are regarded as being inadequate. The Use of Low Site as a criteria for net downs and the reduction for unclassified roads, trails and landings and site degradation should be critically examined.

Rationalization of Information from Other Sources

The Timber Supply Analysis relies on information from other sources such as Silviculture NSR statistics and Protection estimates of unsalvaged losses. The Timber Supply Analysis should reflect similar figures.

Levels of Uncertainty

The quoted and documented levels of uncertainty in the Timber Supply Analysis are regarded as being unacceptable.

Documentation of Inputs and Changes

Data sources and changes in the data were not fully documented.

Documentation of Ongoing Substantial Improvements

Substantial improvements that have been undertaken under the current Inventory Update and in Timber Supply Area Planning are documented.

The District, Region and Branch have undertaken considerable work in terms of improving the forest inventory on the Golden TSA.

These activities include:

- The inventory update which is nearing completion;
- The inclusion of planning cells, biogeoclimatic classification, recreation, operability lines, riparian and ungulate winter ranges and 20-year development plans; and
- The initiatives to improve volume and yield estimates.

TSA Planning activities that have been undertaken in the Golden District reflect the changing timber supply management needs and are both relevant and highly appropriate.

The Golden District has completed the development of 20-year plans for the entire TSA and in the process of developing Total Chance Plans. This activity, coupled with the inventory update, has resulted in the District being in a somewhat unique position in that it has the necessary data to undertake a site-specific Timber Supply Analysis and AAC determination on a drainage basis which can be rolled into a TSA-based timber supply and AAC.

Recommendations for Substantial Improvements

Based on the evaluations of the Inventory and Timber Supply Analysis, a number of areas which have the potential for significant improvement are documented and the following recommendations are presented:

1. A reclassification of the Golden TSA is an immediate requirement.
2. ESA's need to be revised.
3. Yield estimation, both for volume and decay, waste and breakage, requires upgrading.
4. Existing cruise plots should be included in the data base.
5. Volume estimates should be based on taper equations.

6. Differences between cruising and inventory volume estimates should be resolved.

7. Volume estimates should allow the changing of utilization standards.

8. Enhanced capability to report on inventory statistics should be provided. Local Regional and District data summary capabilities addressing local needs should be available.

9. Increased emphasis should be placed on the inclusion of resource values other than forest resources.

10. The dual NSR record keeping of Silviculture and Inventory should be resolved.

11. A Timber Supply Analysis System which is designed to meet both operational and strategic planning needs is regarded as being essential.

    Such a system must allow the determination of timber supplies and AAC by local units, be they planning cells, watersheds or any other specified unit. The timber supply and AAC should be built up from these units. The system must also be capable of addressing geo-referenced stands and must include the capability to handle Local Resource Use Plans and Total Chance Plans.

    It must also include a monitoring system linked to the forest inventory to allow monitoring adherence to the TSA Plan; monitoring of operator performance including operator area profile versus harvest profile, silviculture activity, etc.; monitoring harvest rates, i.e. planned and actual areas and volumes harvested; be capable of monitoring the harvest rate in relationship to the AAC; and addressing other operational concerns and issues. In addition, the system should include a "gaming" or "simulation" capability for scenario testing.

12. It is strongly recommended that the Ministry undertake the development of this system rather than attempt to modify existing systems that may not meet their needs.

13. Data Aggregation procedures should be avoided.

14. A "Test Bed" system for checking the allocation of net downs is regarded as being essential.

15. The Use of Low Site as a criteria for net downs and the reduction for unclassified roads, trails and landings and site degradation should be critically examined.

16. Rationalization of information from other sources that is used in the Timber Supply Analysis is essential.

17. The quoted and documented levels of uncertainty in the Timber Supply Analysis are regarded as being unacceptable. They require resolution.

18. Analysis capability to evaluate changes and trends between analyses is regarded as highly desirable.

19. It is strongly recommended that data sources and changes in the data be fully documented.

20. It is recommended that the lead role in the Timber Supply Analysis be taken by the District. Responsibility for data and processing quality assurance should rest with a single individual.

21. It is also recommended that the Inventory and Planning process be re-integrated at the Branch Level.

22. It is recommended that the District be provided with the required personnel and access to equipment to allow (1) access to data, (2) reporting capabilities and (3) monitoring capabilities. Equipment should include a Geographic Information System.

23. Timber Supply Analyses should not take more than one year from start to completion.

The priorities for funding were considered and prioritized as shown below:

1. Provision of District capability to access and report on data.

2. Implementation of a Timber Supply Analysis System that addresses operational as well as strategic planning needs.

3. Re-inventory of the Golden TSA.

FORTRENDS Consulting Inc.

EXECUTIVE SUMMARY

This is an executive summary of a report, "Technical Review of Forest Inventory and Allowable Cut Determination for the Sunshine Coast TSA". The report was prepared by Fortrends Consulting Inc. in compliance with the requirements of a RFP from the B.C. Forest Resources Commission.

The report is a technical review of:

- Procedures used in the development of the inventory database; and,
- Techniques and procedures used in yield analysis for the Sunshine Coast TSA.

The following summarizes the major findings and recommendations of the report. For more detail and backup information, see the individual sections of the report.

Findings

The findings fall into two categories: those dealing with the overall information system being used by the MOF to support TSA analyses, and those dealing with specific issues in inventory and related databases.

- There is no overall quality assurance/quality control (QA/QC) system in place and operational within the MOF. Such a program is needed immediately to ensure standards of definition and compatibility within and across databases, provide transaction-based control of the data update/change process and provide version and release date control of all major databases.

- The MOF should establish "official", release-dated versions of its data files which are used for planning and analyses. Considerable difficulty was experienced in getting a clean, consistent inventory database file from the MOF due to updates being made continually to the data by groups within the MOF.

- There is considerable pressure within the MOF to begin localized, site- specific planning using GIS technology. The MOF is moving in this direction, however the implementation of this technology appears slow. This project should be sped up in order to begin the build-up of skills at the region and district levels in the application of GIS technology in planning and land use analyses.

- Coupled with the shift to more localized, site-specific planning is the need to upgrade all resource databases and history files. While the unit-level surveys were excellent for their intended purpose, they do not meet acceptable information requirements. Specifically, the planned 1990 re-inventory of the Sunshine Coast TSA does not include any allowance for ground sampling. Our experience has been that at least 20% of the individual stands must be ground sampled if the resulting resource database is to support site-specific, GIS-based planning and analysis. This will require a major re-emphasis in data collection and data management within the MOF.

- One excellent source of supplementary field sample data is via the operational cruise information developed for cutting permits. These data appear directly useable in upgrading the forest inventory, yet they are discarded once the cutting permit for which they were established is approved. Several million dollars are spent annually on cutting permit operational cruises with no benefits accruing to the MOF inventory information system. This seems an obvious opportunity for some efficiency gains.

- In order to properly evaluate yield analysis options, it is essential to have valid, consistent, second-growth natural and managed-stand growth models (yield tables). In the Sunshine Coast TSA analysis, only Douglas-fir was considered for intensive silviculture as this was the only managed-stand growth model the MOF had available internally. This approach is unacceptable. It is essential when dealing with such a vital subject as yield analysis for a TSA, that all applicable and available growth models for as many major species as can be found be used in the analysis.

- The typical planning horizon in TSA analyses is 200-250 years. All information on inventory volumes, growth, silvicultural response and timber characteristics for any yield analysis that goes beyond about 40 years (liquidation of current old-growth) is 100% based upon the growth models (yield tables) used in the analysis process. If the MOF does not have reliable, validated growth models for the silvicultural treatments and species being managed, can these analysis results be considered valid or reliable?

- As part of the upgrade of inventories, it will also be necessary to upgrade the decay, waste and breakage factors for each species. In the Sunshine Coast TSA, only four samples from a 1954 decay study and one from 1979 are within the TSA boundaries.

Recommendations

Only four general recommendations are summarized, others are contained within the text of the report. Most of these would necessarily involve several individual tasks. All are difficult and expensive to achieve, but are essential if the MOF is to conduct appropriate and publicly acceptable TSA yield analyses in the future.

1. The MOF should immediately begin the process of upgrading their basic resource inventories and silvicultural record-keeping systems in order to meet the information requirements of localized, site-specific planning and management.

   As part of this process, the MOF should establish a joint-industry task force to establish guidelines on what data should be collected, the precision levels required and the priorities/importance of the parameters to be sampled.

2. It is recommended that the MOF immediately begin the task of establishing and implementing a Ministry-wide Quality Assurance/Quality Control (QA/QC) program which would be used across all resource and planning databases. Such a QA/QC program would ensure compatibility and consistency among parameters within and between databases, would maintain a transaction-based control system for the update/change process and provide version and release date control.

3. The MOF must immediately begin the process of acquiring and calibrating all available (including models developed external to the MOF Research Branch), successful, regional, natural and managed-stand growth models for all major tree species in the province. It is inappropriate to conduct yield analyses without appropriate natural-stand and managed-stand growth models for all major species present in the TSA.

4. Polygon-level, site-specific planning using GIS technology is already being attempted. The MOF have already acquired such technology, but implementation has been slow. It is recommended that the MOF accelerate implementation of this technology, starting at the region level. In this way a pool of qualified, experienced staff will be available to apply the technology as soon as adequate data is available.

Hugh Hamilton Ltd.

EXECUTIVE SUMMARY

This technical review of the Quesnel TSA is intended to advise the Forest Resource Commission whether there is significant technical grounds for public concern about inventory and Annual Allowable Cut.

The consultants found that the forest inventory was appropriate at the time it was done but is marginally adequate today. The maintenance and update of the inventories has been neglected, resulting in low confidence by users. The total TSA needs a general re-inventory and then enhancements should be focused on areas which warrant the need.

The Ministry of Forests put a lot of effort into the yield analysis. Regional staff tried long and hard. Good co-operation with the industry and limited co-operation with the Ministry of Environment was achieved. The yield analysis took too long, was too complicated and the end results were disappointing. There is a real need to disentangle land use policy and technical calculation procedures. Simpler, faster and more revealing analytical techniques than those used now should be adopted. This report includes the following subjects:

- History;
- Assessment of inventory maps;
- Assessment of the inventory data base;
- Assessment of the overall accuracy of inventory data;
- Assessment of yield analysis procedures;
- Variability of yield analysis results;
- Discussion of the Quesnel TSA allowable cut;
- Related factors;
- Recommendations.

The consultants have made the following eight recommendations:

1. The forests of the Quesnel TSA should be re-inventoried as soon as possible with emphasis on younger stands and forest types which are recently an adequate base inventory for all forest resources in the TSA.

2. Forest inventory procedures should be improved so that inventory and data can be used with confidence at a watershed and development plan level. The present re-inventory process is not adequate. These re-inventories are elaborate updates.

3. New volume plots should be weighted to immature stands and other known gaps in our data (for example, important high elevation types). This new data would be incorporated in the new volume estimation and yield projection system for natural stands, developed by the MOF. Yield projections for managed stands must be improved.

4. Regular comparisons should be made of inventory versus cruise versus scale volume estimates. Causes of discrepancies should be identified, and recurring problems in estimating techniques should receive corrective action.

5. It should be recognized that the AAC calculation is not a surrogate for forest land management. The political aspects of the calculation (e.g. land use policies) should be separated from the technical, computational aspects. Policy matters should be dealt with by a separate, local body which is authorized to make public policy decisions. Once this has been done, technical matters, like yield analysis calculations, can proceed with clear objectives and fewer impediments.

6. The calculation process should be simplified. A forest simulation model be substituted for linear programming techniques and MOF planners should be encouraged to use the model to understand the dynamics of the forests under analysis.

7. The allowable cut calculations should be done in the MOF regional office by regional and district staff. The Victoria function should be data preparation and manipulation, and auditing regional calculations.

8. The quality of analysis must be improved. It should be focused on specific problems. The analysis should provide an informed description of these problems and discover at least one practical solution for each. The analysis should be prepared to find surprises which may alter pre-conceived notions. A rigid mechanical process will not satisfy requirements. The process should use the intelligence and understanding of local professionals in the thinking part of the analysis.

Industrial Forestry Service Ltd.

EXECUTIVE SUMMARY

This report provides a technical review of the current Allowable Annual Cut (AAC) of the Fort St. John Timber Supply Area (TSA) as well as a review of the inventory data analyzed in support of the AAC.

Recent history of inventory and analysis procedures is included to provide an understanding of the derivation of the current inventory and analysis procedures investigated as part of this review.

Assessment of Inventory

- Forest inventory maps lack sufficient detail to be used for operational use but are adequate for yield analysis purposes.

- Forest cover type labels are not very accurate partly due to policies and procedures in place at the time of inventory and partly due to changing species composition over time. The latter is a problem unique to the mixed-wood forest types of the Peace Region of the Province. The potential impact on yield does not exceed ±10%.

- Environmentally sensitive areas (ESA's) are adequate, considering the scale of photography used for delineation. There is, however, a potential for up to 6% more of the net land base to be classed as environmentally sensitive due to sensitive soils which may be identified in Pre-harvest Silviculture Prescriptions (PHSP's).

- The current reinventory covering a large portion of the TSA was prompted in part by the need for an improved classification of deciduous types. The reinventory, however, has shown that the coniferous classification was also inaccurate.

- Volume can be assigned to the individual forest cover types in the inventory using the Ek-Payandeh volume-ratio model. Estimates of volume and species composition are generally within the range of acceptable values on a TSA basis using "capped" Ek-Payandeh curves, but volumes are rarely accurate on a site-specific basis.

- Coniferous loss factors applicable to the Fort St. John TSA cover many forest inventory zones (FIZ's) and may be unreliable. Deciduous loss factors are extremely variable and tend not to be correlated to external tree indicators but on average are reasonable.

- The procedures used to calculate unavoidable waste (W2) loss factors for application to Volume-Over-Age Curves (VAC's) appear to under-estimate the resultant loss factors, but the impact on the AAC is not significant.

- The procedure used to calculate site index for individual forest types is not very accurate because class-based variables must often be used for age and height. However, over the total TSA the use of mid-points of classes instead of actual values has a minimal effect on the AAC.

Assessment of Yield Analysis Procedures and AAC

- The current AAC is based on two separate analyses:

  1. The coniferous AAC for the Fort St. John District analyzed as part of the Peace TSA.

  2. The total AAC (coniferous and deciduous) analyzed as the Fort St. John TSA.

  The deciduous AAC has been calculated as the difference between the two analyses.

- The current AAC for the TSA is:

Coniferous:	900 162 m^3
Deciduous:	915 000 m^3

- The entire coniferous AAC is presently allocated and utilized. The deciduous AAC is allocated and not utilized at this time.

- Reductions made to determine the net land base may not be adequate for the following reasons:

  1. The allowance of 5.5% of the current land base to non-productive following the first harvest may not be adequate. Although the impact may be lessened due to the high proportion of winter logging, up to 15% of many sites may be adversely affected by harvesting. In addition, significant areas of the TSA are being lost to rights-of-way and seismic activity.

  2. Problem forest type reductions for coniferous types are comparable to other TSA's and are probably reasonable. Deciduous reductions do not appear to be realistic as shown in the following table:

	Coniferous	Deciduous
Gross Potential Land Base (ha)	1 045 811	581 126
Problem Types (ha)	648 000	33 000
Net Land Base (ha)	397 011	548 126
% Problem Type Reductions	62%	6%

  3. The impact of planned range burning for domestic cattle and wildlife does not appear to be adequately allowed for, resulting in an overestimate of the deciduous AAC.

  The deciduous AAC may be overstated by about 400 000 m^3 due to the above problems.

- The use of "uncapped" Ek-Payandeh VAC's overestimates current coniferous mature growing stock. Correcting for this problem would reduce the number of years to commencement of falldown from 50 to 10.

- The use of "uncapped" Ek-Payandeh VAC's also overestimates the current deciduous growing stock but the impact of this problem is minor compared to the overstatement of yield caused by failure to allow for deciduous problem forest types.

Table 1

AAC	Technical Issue	Potential Impact of Issue
Coniferous	Modelled - 910 000 m^3 Current - 900 168 m^3	Provides minor conservative margin
	Additional area in net coniferous land base	Increases LRSY by about 7%
	VAC's overestimate mature volume	Reduce years to falldown from 50 to 10
	Intensive Silviculture (if carried out in initial 30 years)	Permits extensions of years to falldown from 10 to 30 and increases LRSY by 226 000 m^3/yr
	Unsalvaged Losses underestimated	Eliminates falldown and increases LRSY after 110 years to 1 057 000 m^3/year
	Residual Types excluded	Potential to increase LRSY by up to 3600 m^3/yr.
	Loss Factors	No measurable impact but factors are potentially inaccurate
	Rights-of-way may be underestimated	Potential reductions to AAC of about 2%
Deciduous	Modelled - 950 000 m^3 Current - 915 000 m^3	Minor conservative margin
	Problem Type Area Inclusion Factors not applied	Possible reduction to LRSY of about 400 000 m^3
	VAC's overestimate mature volume	Minor reduction to short-term harvest but no effect on LRSY
	Range Burning	Reduction to LRSY of about 5% but not a factor if problem types allowed for
	Residual Types excluded	Potential to increase LRSY by up to 10 500 m^3/year
	Rights-of-way may be underestimated	Potential reductions to AAC of about 2%

- Planned basic silviculture regimes for coniferous stands cause stand conversions following the first harvest which do not affect the long-term harvest. However, planned conversions in deciduous stands result in an approximately 6% decrease in Long-Run Sustainable Yield (LRSY). This suggests a need for a review of the silviculture regimes.

- Intensive silviculture programs originally planned to increase LRSY in the future are included in the yield analysis but have not as yet materialized.

- A significant increase in the coniferous land base appears in the 1987 MOF analysis of the combined yield for both coniferous and deciduous stands compared to the coniferous yield analysis carried out in 1985. This provides a substantial potential increase in yield to offset the impact of the overestimate of the current coniferous growing stock.

- Unsalvaged losses are overestimated for the coniferous AAC because fire losses are much less than previously estimated, are usually salvaged and were accounted for in the allowance for non-satisfactorily restocked and non-commercial brush areas. The reduced requirement for non-recoverable losses provides an additional offset for the overestimate of the volume of the current mature timber.

Table 1 summarizes yield analysis impacts.

Other Technical Issues Investigated

Other technical issues investigated which did not impact on AAC included:

Inventory

- Classification
- Disturbance updates
- Inventory ground truthing
- Base mapping

Analysis Procedures

- Crown land lost to timber and forage production prior to the analysis
- Aggregation of forest types into analysis units
- Stocking factor adjustments
- Forest estate model used

Recommendations

- Extend the current reinventory to cover major concentrations of coniferous.
- Initiate increased local sampling for volume in mature and immature stands.
- Localize loss factors to the Fort St. John TSA.
- Develop VAC's which reflect actual mature volume for the first rotation.
- Develop VAC preparation procedures which allow for species succession.
- Incorporate residual types in the yield analysis if they can be utilized.
- Apply coniferous AIF's to deciduous types until experience in utilizing deciduous types can be used to define the deciduous net land base.
- Examine mixed-wood management opportunities to maximize recovery of minor species components.
- Ensure that the planned and intensive silviculture programs are carried out as modelled.
- Re-evaluate planned silviculture regimes because they appear to produce a small net decrease in overall yield.
- Monitor losses so that unsalvaged losses can be updated at the next analysis of the AAC.

- Investigate land base and productivity losses due to soil degradation from harvesting operations for input to the next analysis.

- Monitor seismic activity and make appropriate adjustments to the land base for the next analysis if necessary.

- Acknowledge the fact that forest inventory will be used for more detailed planning purposes and investigate the possibility of modifying procedures to provide more localized and reliable data for GIS applications.

- Future analyses should evaluate the coniferous and deciduous AAC's separately because the apportionment and the commitments under licences are separated.

Sterling Wood Group Inc.

EXECUTIVE SUMMARY

Sterling Wood Group Inc. was commissioned to conduct a review of the inventory and the procedures leading up to the determination of an allowable cut for Tree Farm Licence 35 (TFL 35).

TFL 35 is a relatively small management unit located just north of Kamloops. It is well accessed, all the productive land area is operable, and the timber growing capabilities of the land is said to be above average for the area.

Weyerhaeuser Canada Ltd. has held the licence since 1970 (it was renewed for 25 years in 1980), but the TFL was first issued in 1959 to B.C. Interior Sawmills Ltd.

This review has focused on Management and Working Plan No. 7, recently prepared by the licensee and approved by all technical levels of the Forest Service. It awaits completion of the public review process and final approval by the Chief Forester. The current Management and Working Plan No. 6 is now in its eighth year. It is obsolete and there was little point in reviewing it except in an historical context.

The review process has included a thorough evaluation of the timber inventory, including forest classification, photo interpretation, sampling for data and transfer of information onto forest cover maps. Information to supplement the inventory, such as loss factors and growth and yield curves have also been reviewed. These were all used by the licensee quite recently to conduct a timber yield analysis which provided a forecast of future yields and harvest levels. This in turn was used to determine the proposed AAC. We have also examined the yield analysis process - particularly, the assumptions used and the management obligations embedded in the process. This report comments on the adequacy and accuracy of the inventory and its supplements, and documents the concerns felt by the licensee, the Forest Service and ourselves. Finally, the report lists the shortcomings of the inventory, yield analysis and AAC determination process and sets out some recommendations for change.

In our assessment of the current inventory, the maps and timber type labelling we found that the last full re-inventory was done in 1978. This has been augmented with updates which reflect the harvesting, planting, etc. that has taken place in the meantime. While the inventory is now quite old and should have been replaced during the last Management and

Working Plan Period, we found that the photo information, classification and mapping had been done very accurately. The quality of the photos was mediocre but the skill of the phot interpreters seems to have overcome this handicap so that there would have been very little change to the inventory had the photos been of better quality.

A noticeable gap in the inventory is any proper allowance for Environmentally Sensitive Areas (ESA's). Some acknowledgement is made for soils and slopes susceptible to erosion on a separate resource folio map and a land base adjustment is made in the yield analysis. No allowances at all are made for constraints that might be imposed to protect fish, wildlife, recreation or water quality or for areas which could be difficult to regenerate.

The inventory data base is based on the Forest Cover maps and is up to date. Not all silviculture history information has been transferred to the data base although it is complete and on the forest cover maps.

A concern to many is the use of the Managed Stand yield curves developed by the Forest Service Research Branch. They result in very significant increases in forecast growth making many inventory professionals nervous because they are difficult to substantiate or refute. On the other hand, we have noted instances where extra pains have been taken to be conservative, and there are other professionals who believe the yield curves underestimate the potential yield.

There is a complete lack of data on fish and wildlife populations on the TFL (as is the case on almost all management units in B.C.). In the long run, this will become intolerable as more and more timber management decisions are made to accommodate other forest uses.

Weyerhaeuser has its own yield analysis model developed by its parent U.S. company. This High Yield Forestry (HYF) model is similar to those commonly used by the Forest Service who have tested it and found it to give similar results. We are satisfied that it is adequate to carry out the yield analysis and to help in the determination of the AAC. A number of allowances and deductions are standard procedure for TFL and TSA yield analyses. We reviewed these, including: allowances for decay, waste and breakage; area deductions; volume deductions for deciduous timber; and allowances for non-recoverable losses. Apart from inadequacies of ESA allowances, the allowances appeared to be more than adequate. The licensee attaches a great deal of importance to the application of a higher standard of silviculture on the TFL. It plans to regenerate areas earlier, plant more, control stocking and

regenerate areas which have been disturbed but not restocked for many years (Backlog NSR). The silviculture aspirations of the licensee are realistic but will require an increased level of effort and money to achieve. The Forest Service will be monitoring the performance of the licensee to ensure that the assumptions are being fulfilled and, as a safeguard, the proposed new AAC will not come into force until 1993 after a report on performance.

The licensee used the yield analysis to test a base case scenario, where a basic forestry regime was employed, and an incremental forest management scenario, where all the extra silvicultural and management assumptions were used. In the basic option, the model simulated the management of the TFL so that all currently logged areas are managed as necessary to ensure that they meet basic forestry requirements. No backlog NSR areas are treated. In the incremental forest management scenario, the model simulates a management regime where all currently logged areas are managed as necessary to ensure they are producing at or near their biological potential. Some treatments are carried out on backlog NSR.

We are satisfied that the yield analysis has been carried out properly, the deductions and assumptions are realistic (if conservative) and that it forms an adequate basis upon which to determine the AAC for TFL 35.

The licensee is seeking final approval for an allowable annual cut of 130 000 m^3 for the present TFL area. This is in contrast to the existing AAC of 88 000 m^3. Actually, there is to be a reduction of TFL area by about 5% as an allotment to the Small Business Forest Enterprise Program. This will result in an AAC for the remaining area of 125 600 m^3. The 50% increase in cut being proposed is alarming to some. First of all, the public may be astonished when such an increase is proposed at a time when there is a general perception that our forests are being overcut. A satellite photograph of the TFL is attached at the back of this report and at first glance, lends weight to the overcutting argument. However, the image enhancement of the photograph shows all areas of disturbance regardless of their age. Many of these areas are now well toward production of their second crop and the dimension of time should be used to temper the impressions given by the photo.

The local Fish and Wildlife officer is also concerned about the increase in harvest level. The licensee is being required to undertake a study of the impact of the higher harvest level on fish and wildlife habitat. The adoption of the proposed AAC in 1993 is dependent on a satisfactory outcome to this study.

Finally, there are Forest Service officers who are sceptical of the Managed Stand yield curves which have contributed so much to the forecast increase in yield which has in turn enabled a much higher harvest level to be justified. Their fears will only be confirmed or allayed with time and the collection of more data.

In the report, we recognize that forest yield prediction is an inexact science, that there are those who would feel more comfortable with a more conservative approach, and there are those who feel it is time to operationally test the predictions and forecasts made by foresters and biometricians.

Our assessment is that forest management will be better served by taking the step toward a higher level of silviculture. Inevitably, adjustments to the forecast yields and AAC will be required. We have observed how the process has used a lesser figure or a higher deduction at times when there is some uncertainty. These conservative measures could well compensate for any overestimation of yield. In any event, we would anticipate little actual harm being done should the yields turn out to be overly optimistic, provided this can be detected reasonably quickly.

We have therefore concurred with the licensee and the Forest Service that the AAC for TFL 35 should be increased to 125 600 m^3 contingent on the licensee fulfilling the obligations and expectations for silviculture and for fish and wildlife planning.

We have commented on some shortcomings in the inventory, data base and yield analysis and expressed an opinion of the consequences. There were no major shortcomings identified. Perhaps the most significant is the lack of information on Environmentally Sensitive Areas. We also point out that the inventories of other resource values - particularly fish and wildlife - is inadequate.

Finally, the report suggests some recommendations for improvement to the inventory, data base and yield analysis. In summary, these include:

- A re-inventory of the TFL using new photos;
- Delineation of ESA's;
- New inventory sample plots positioned to provide maximum coverage;

- Consideration of inclusion of deciduous species as merchantable volume in the next inventory;
- New mapping standards and compatibility with the Forest Service GIS formats;
- More research into Growth and Yield on the TFL;
- Development of local loss factors on the TFL, possibly stratified by bio-geoclimatic zones;
- Carry out an inventory of fish and wildlife populations on the TFL;
- Review the need to extend the inventory to sub-unit levels;
- Provide for tighter commitments by both the licensee and the licensor that obligations set out in the Management and Working Plan are fulfilled;
- The Forest Service should develop a plan and outline the procedure to be used in monitoring the fulfillment of silvicultural and other obligations.

Stewart & Ewing Associates Ltd.

EXECUTIVE SUMMARY

A review has been carried out to assess the accuracy of timber inventory data, and to assess validity of the allowable annual cut for Tree Farm Licence No. 6 held by Western Forest Products Ltd.

Accuracy of the timber inventory was assessed by reviewing inventory procedures used by the Licensee. Each step in preparing the inventory, from forest classification through field sampling, and volume compilation was examined, and conclusions were drawn regarding adequacy of the procedures. Methods used to update the inventory were also examined. It was found that proper inventory and update procedures have been used by the Licensee, and that high work standards have been maintained throughout. The use of high standards is borne out by a low sampling error of less than 1%.

Accuracy of the timber inventory was also assessed by carrying out two extensive checks in which inventory volumes were compared with actual volume harvested. These checks indicate that the volume of mature timber shown in the inventory may be overestimated by 10-12%.

In view of the high work standards, and the very low sampling error, it has been concluded that the most likely cause of any overestimate in volume of mature timber is the use of MOF global volume equations and loss factors which have not been adjusted for local use on TFL 6.

Scope of the review did not permit any checks to be made concerning accuracy of the inventory of second-growth stands. Since the cut for the next four decades will come from liquidation of old-growth stands, any minor inaccuracies in the second-growth inventory will not significantly affect the allowable cut during the near term.

Accuracy of the allowable cut cannot be tested numerically until the need of the first rotation. However, the process used by the Licensee to determine the cut was reviewed, and conclusions were drawn regarding validity of the methods and results.

The Licensee carried out a single yield analysis for the status quo option as part of the preparation of the current Management and Working Plan (No. 7; 1987-1991). The analysis was done using a standard computer growth model known as the Multiple-Use Sustained

Yield Calculator. The review consisted of examining the input data used such as site classification, yield tables, and harvesting age, and reviewing the correlation between management assumptions and actual practice. Results from the computer run were also examined and the allowable cut calculated by the computer model was compared with the proposed allowable cut.

It was found that the proposed allowable cut is reasonable and supportable, based on using the available site curves and yield data. Results of the review indicate that existing global site and yield data may not be reliable for local use on TFL 6.

Confirmation of the accuracy of site curves and yield data for local application is a matter that requires immediate attention. Reliable growth and yield data is essential for proper long-term attention. Reliable growth and yield data is essential for proper long-term management, even though changes in the forest inventory, or growth rates, are not expected to result in a significant change to the AAC during the near term.

In summary, it is concluded that, while the timber inventory was properly carried out by the Licensee, it appears that the volume of mature timber may have been overestimated by 10-12% as a result of using volume equations and loss factors that are not applicable to TFL 6. It is also concluded that the proposed AAC is proper, and can be supported during the next few decades.

Recommendations are summarized as follows:

1. Further studies should be carried to confirm the volume of old-growth timber on TFL 6.

2. Site curves and yield tables should be confirmed for use on TFL 6.

3. On completion of the above two steps, the improved data should be used to rerun the yield analysis.

4. Present disincentives to mensurational studies being carried out by industry should be eliminated by introducing new Ministry of Forests policy.

5. A central agency, with long-term funding, should be established to plan and carry out urgently needed mensurational studies.

Sylvametrics Consulting

EXECUTIVE SUMMARY

Summary of the Conclusions

The technical review of the inventory data and the AAC analysis is covered in Part II of this report, and certain aspects are dealt with at depth in Appendices D and E. The principal conclusions and recommendations arising out of the technical review are summarized here. The management issues underlying these conclusions and recommendations are discussed in the following section.

Scope of the Review

During the course of its work, the Forest Resources Commission has been often told that:

- The forests are being overcut;
- Forest inventory data is incorrect.

In order to determine whether or not there is any basis in fact for these statements the Commission has embarked on a review of inventories and allowable cut analyses for a sampling of forest management units - four Timber Supply Areas, and three Tree Farm Licenses (TFL's). TFL #51 is one of the units selected.

The terms of reference that the Commission set down for the study centre around two major questions about the inventory and allowable cut analyses:

- How accurate and appropriate is the inventory and growth and yield data that has been available for allowable cut analysis, and how good has the analysis been?

- Given the decisions that have to made for allowable cut, other uses of forest land resources, and wise public resource conservation, are the inventory and growth and yield standards and procedures appropriate, and do they yield data that is accurate and sufficient to support the decisions?

Principal Conclusions

- The inventory data and allowable cut analysis used in the present working plan are weak but sufficient to determine an allowable cut that does not jeopardize future management of the TFL.

- Timber harvesting comes into conflict with other resource management objectives, and the integration of these objectives in forest management planning is inadequately served by present data and analysis.

- Although the present allowable cut is appropriate, the forest has been overcut in the past. Inadequate stocks of good quality mature timber now remain to allow a smooth transition to managed forest.

- Planning assumptions about forest management are inconsistent with the reality of the natural forest succession that exists in the region, and with the standards applied in practice.

- Current silviculture guidelines, based on biogeoclimatic interpretation, are inconsistent with harvesting practice and planning assumptions, and are not supported by financial analysis.

Principal Recommendations

- Inventory data and forest management planning procedure should be based on integrated resource management objectives.

- Integrated resource management should be the responsibility of the license holder.

- Inter-agency regulation of resource management should be consolidated beyond the referral system that currently exists.

- Regulation of forest harvests should be stratified by forest type, and area cut regulation should be considered as an alternative to volume cut control.

- Growth and yield study should concentrate on the natural stand succession that characterizes the forests in this region.

- Financial analysis should be applied in the development of silvicultural regime prescriptions under the biogeoclimatic interpretation system.

Discussion of the Underlying Management Issues

The investigations connected with this review have identified a number of issues that are critical to forest management and forest management planning at this time. These issues are discussed here so that the Commission can formulate forestry policies that will ensure rational, productive, and socially acceptable management of public timberlands.

Integrated Resource Management

TFL #51 is situated in a forest region where significant multiple use demands have to be accommodated by forestry management. In addition to timber management, the area is very important for fisheries, wildlife management, tourism, and native cultural heritage. Timber harvesting objectives and practice have often conflicted with other forest land uses and these conflicts are escalating.

In order for forest management planning to deal effectively with these issues, a number of information requirements can be identified:

- Clarification of the non-timber resource user demands and management objectives;
- Interdisciplinary assessment of the forest management activities required to sustain non-timber resource production and protection;
- Determination of the opportunity costs to forestry management of implementing practices that facilitate integrated resource management.

The present non-timber resource inventory data is very weak, and is inadequate to support integrated resource management planning in the future. The present ESA mapping only highlights areas where protection of non-timber resource values has to be considered either by non-disturbance, or by extra care in the timber development. ESA mapping does not provide any information about the quantities non-timber values that the land can produce - tonnes of salmon per year, user-days of camping, moose and deer units, etc.

Forestry management objectives have to be re-assessed in light of greater recognition of the multiple benefits that the forest provides. An example of this is the brush problem in the Cranberry valley bottomlands. Past harvesting practices created the problem. These lands have considerable timber-growing value, and the timber management objective is to rehabilitate them to commercial timber production. However, from a non-timber resource perspective, the Cranberry flats may offer enhanced values in their present state. They are

visually very attractive in the tourist season, and the fisheries and wildlife management values are high.

Although public timberland, TFL #51 is privately managed for timber. This gives rise to several questions about the administration of the TFL for integrated resource management:

- Who should pay for this additional inventory and planning work?
- Who should be responsible for ensuring that the integrated resource management plans are implemented?
- How will the opportunity costs for forestry be reflected in timber pricing?

The present inter-agency referral process used in all stages of harvesting planning is not adequate for future resolution of integrated resource management. The interdisciplinary effort in forest management planning must be more cohesive and pro-active. Re-alignment of resource legislation and responsibilities in government agencies may be necessary to attain the cohesion needed. Additionally, the forest land managers need to be given greater responsibility and accountability over all the resource management activities that occur on the management units that they supervise.

One lingering social question remains. How will the reduction in public revenues, resulting from greater integrated resource management, be compensated for - increased revenues from other resource uses or what?

Harvesting Practice

The forest profile in the region is diverse due to centuries of fire disturbance, and the range in timber stand values is large. In the present century, this disturbance has been greatly accelerated by farming and logging activity. The initial logging focus was primarily the large spruce that existed in the valley bottoms. The extensive upland decadent hemlock forests were avoided, as well as the seral aspen and lodgepole pine stands. In short, the most accessible and profitable timber stands have been exploited - the forest 'profile' has been 'highgraded'.

The pattern of past timber harvesting is abundantly clear on the ground, in the harvesting records, and on the inventory maps. The result of these past practices is also abundantly

clear - sustaining profitable timber harvesting into the future is going to become difficult. This will require much better inventory information and more refined planning practices than have been used in the past.

Although pulp production was fostered by government in the early days, partly as a means of utilizing the decadent forest component, the regional forest industry is currently very much sawlog oriented. There is no or little market for deciduous, and there is insufficient demand (and price) for pulplogs. As with the interior pulp industry, the pulp furnish is mostly chip residue from lumber production. The inability of the forest industry to utilize the full profile of the forest must be a major consideration in forest planning.

The harvest regulation policies under which allowable cuts are developed and administered have aggravated this "highgrading" pattern of development. Cut control policies that are inconsistent with the realities of market cycles for forest products have exerted upward pressure on harvest volume, which has had to be compensated by even greater concentration of harvest in the best timber.

The allowable cut has always been a global limit, with no distinction being made about how the harvest is distributed over the inventory profile of the forest. Harvest planning and regulation should apply constraints on the distribution of the harvest, so that sufficient high value timber is conserved for future needs.

Harvest regulation need not be by volume. If it was by area, then some of the problems would be reduced. It is recommended that the effect of forest regulation policies on the pattern of forest development be investigated by the Commission.

A significant weakness of the present inventory is the information available to determine the future limits to economic accessibility. The present operability lines are inadequate, and need to be replaced by soils and slope class mapping, and access engineering, so that accessibility can be re-evaluated under changing economic conditions.

Not only will planning for future harvests have greater difficulty in identifying an adequate harvest schedule, but the harvesting and manufacturing methods will probably have to change to generate maximum recoveries from the stands scheduled for harvest. Large clearcuts have been favoured in the past, but the older immature forest that will increasingly be harvested in the future is usually a seral stage of forest development, and it may be

necessary to harvest the short lived deciduous species and the pine without destroying the younger hemlock dominated stand that is developing. This may mean radically different harvesting practices. Additionally, the overmature hemlock forest that has been avoided in the past is very decadent, and the sawlog output may be very limited. This poses some challenges to manufacturing - re-constituted board products instead of sawnwood? All these complicated aspects of future timber utilization have to be considered in working plan development.

Silviculture, Growth and Yield

To-day, it is everywhere apparent that forest development is highly influenced by a natural succession through pine and deciduous cover, to the shade-tolerant and longer living hemlock, spruce, balsam, and cedar. Planting of pine and spruce may accelerate this succession, but it does not supplant it, without significant stand tending treatment.

Earlier logging was usually followed by slashburning for site preparation, and then planting with pine or spruce. Birch and other hardwoods have colonized these burned areas, and in some spruce leader weevil is a significant problem. Below the deciduous cover the natural regeneration of hemlock and spruce is significant. In recent years slashburning has been virtually eliminated. A mix of pine and spruce is planted, sometimes with microsite selection being left to the planters.

The Ministry of Forests publishes biogeoclimatic (BGC) interpretation guides that contain silvicultural guidelines. These guidelines generally are followed in the preparation of pre-harvest silvicultural prescriptions (PHSP's), and have been adhered to reasonably well on TFL #51. These silvicultural guidelines make some presumptions about subsequent stand management and return on investments that the consultants cannot accept as valid.

For example, hemlock is the premier climax species over most of the TFL and will in time colonize most regenerated sites. Yet spruce and pine are recommended as the preferred species for planting in nearly all BGC associations. This just does not make sense, as it commits forest management to a lifetime of fighting the hemlock ingrowth, and in the case of pine plantations, it dooms the thrifty young hemlock understorey to serious damage when the pine is removed.

Aspen and birch will quickly colonize new plantations in the TFL, and the spread of aspen in clearcut areas is aggravated by the limited slashburning. Although spruce plantings may usually hold their own against the deciduous, pine may often succumb to the competition from the aspen. Although the BGC guides suggest brushing and weeding may be a necessary follow-up activity to pine and spruce planting, the TFL management will be highly reluctant to make the expenditures if the stand can just make it to "free growing" without them.

The present practice of planting admixtures of pine and spruce must also be seriously questioned. With the aspen, birch, and hemlock ingrowth, these plantations will become multi-storied seral stands that will be very difficult to manage. Aspen and pine utilization will have to occur significantly before spruce and hemlock utilization, if the merchantable growing stock of the stands is to be fully utilized. On the other hand, if the intent is to harvest these stands on a single entry clear-cut, then a significant amount of the merchantable growing stock will be lost, and the return on management investment may be seriously impaired. It will take far more innovative and sophisticated approaches to harvesting to obtain maximum utility from these stands than have been applied to date.

Why not grow hemlock, and help it along by brushing and spacing? It will be a much cheaper and easier to manage?

The BGC guidelines for bottomland associations, where spruce and cottonwood management are favoured, seem to be reasonable. However, the management of these bottomlands will be very complicated, as the cottonwood study for the TFL has indicated. The single species stands that can be developed in these associations will be in very small patches. Again, forest harvesting practices in the future will have to be radically different from what they have been in the past if commercial forest crops are going to be successfully managed in these areas.

None of the BGC silvicultural guidelines seem to be supported by rigorous development of technical regimes, yield tables, and financial analysis. It is highly appropriate that the BGC interpretations lead to rational prescriptions for future management, but these prescriptions have to have a much surer footing than they do now. The consultants strongly recommend that growth and yield research efforts focus on the development of silvicultural regimes that make sense from a financial management perspective, as well as being biologically sound.

The management assumption used in the AAC analysis were inconsistent with both present regeneration practice and the BGC guidelines. While this had no appreciable impact on the AAC volume determined, future management and working plans should be based on a more plausible set of management assumptions.

APPENDIX C

GLOSSARY OF TERMS

GLOSSARY OF TERMS

Allowable annual cut: Abbreviated **AAC**, the allowed annual rate of harvest from a forest estate. MOF policy states that AAC for all TFL's and TSA's will be reviewed at least every five years.

AAC Rationale: The long-term timber supply objectives and the broad management assumptions and strategies upon which an AAC is based. These include, for example, the harvest forecast, the net land base, timber harvesting priorities and constraints, timber utilization levels and standards, levels or unsalvaged losses.

Analysis unit: A term used in timber supply analysis to define the aggregations of timber inventory data used in the analysis process. It is the basic building block around which inventory data is assembled for use in forest estate models.

Area inclusion factor: Abbreviated **AIF**, a percentage that is applied to the productive land base used in the yield analysis to reduce the land base and reflect environmentally sensitive areas, inoperable areas, loss of productive land base due to harvest activities, etc.

Biogeoclimatic zone: Abbreviated **BGCZ**, a definition of an area that has similar biological, geographic and climatic conditions.

Culmination of mean annual increment: Abbreviated **CMAI**, the point at which a timber stand reaches its maximum annual volume growth for a defined utilization standard.

Data assumptions: Analytical approximations and representations of the physical, biological and economic characteristics of the forest resource and its development over time. These include, for example, the forest inventory, yield projections and reforestation costs.

Environmentally sensitive area: Abbreviated **ESA**, this definition is an inventory criterion to account for and protect forest resource values other than timber.

Extended grid area file: Abbreviated **EGAF**, the file name used by the MOF to define inventory data base files that are grid based, not polygon based. These files predate FIP files and are in the process of being converted to FIP files.

Forest estate: A term used to define the gross land base of a particular forest resource management unit.

Forest estate model: An analytical computer-based model that successively "harvests and grows" forest stands within a forest estate over a period of several decades according to specific data and management assumptions.

Forest inventory planning (file): Abbreviated **FIP**, the file name used by the MOF to define inventory data base files that are polygon specific.

Forest inventory zone: Abbreviated **FIZ**, there are 12 FIZ in the Province. They were established as an inventory strata to define areas with similar individual species growth and yield functions.

Geographic information system: Abbreviated **GIS**, a tool that allows for the combining of computerized map information with data base information.

Growth model: A model that "grows" individual forest stands to predict possible growth and yield outcomes from a variety of treatments.

Inventory polygons: A group of trees that have similar characteristics in terms of species composition, age, density and growth potential.

Long-run sustained yield: Abbreviated **LRSY**, a yield analysis term used to define the product of a chosen MAI multiplied by the net operable land base appropriate to that MAI and the summed for the forest estate.

Managed stands: A term given to timber stands that have originated from some form of artificial event (e.g., planting) or natural stands that have been subjected to some "management" treatment (e.g. spacing).

Management assumptions: Analytical approximations and representations of management objectives, priorities, constraints and other conditions. These include, for example, the criteria for netting down the land base, the specification of minimum cutting ages, utilization levels and standards, cut/leave ratios and the assumed silviculture and pest management programs.

Mean annual increment: Abbreviated **MAI**, a measure of the average annual volume growth, to a defined utilization standard, of a stand to a particular age.

Multiple Use Sustained Yield Calculation: Abbreviated **MUSYC**, a linear programming forest planning model developed by the U.S. Forest Service. MUSYC is currently used as the MOF standard forest estate model for carrying out TSA timber supply analyses.

Natural stands: A term given to stands that have originated from natural events.

Net Productive Land Base: The portion of the total land area of a management unit which is considered to contribute to, and be available for, long-term timber supply. The net land base is defined for an option by reducing (or "netting down") the total (or "gross") land base in a manner consistent with the management assumptions for that option.

Non-commercial brush: Abbreviated **NCBr**, a definition given to a forest stand that is NSR and overgrown with non-commercial brush species.

Not Sufficiently Restocked: Abbreviated **NSR**, a definition given to a forest stand that does not contain a sufficient number of acceptable species to meet reforestation standards.

Public Sustained Yield Unit: Abbreviated **PSYU**, were administrative units defined by the MOF for the purposes of yield analyses and AAC determinations.

Regeneration delay: The number of years between the denudation of a forest stand by harvesting or natural causes and the establishment (germination) of the next crop. The point at which the next crop is regarded as established must be consistent with the origin of the yield projection which will be assumed to describe the yield development of the next crop.

Site index: A measure of site productivity. Site indices are based on tree height as a function of stand age and usually expressed graphically as site index curves.

TSA Plan: The forest management plan developed for a TSA. The TSA Plan establishes the long-term supply objectives and the broad management strategies for the timber, range and recreation resources in the TSA. For the timber resource, the TSA Plan establishes an AAC and 20-year licensee operating areas.

Unit survey: Term used to define the MOF's inventory design and program started in the mid-1960's.

Yield projections: Forecasts of future yields from forest stands or timber types. Yield projections can be developed for stand volume, stand diameter, and for empirical (averagely stocked), normal (optimally stocked) or managed stands. Yield projections can be based on a number of mensurational approaches and procedures, including the use of site index curves and generalized growth models.